Transfer Function Solved Problems

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Guidar Home Evening

Problem 1:

Find the Transfer function of the following RC circuit

Applying Kirchoff's voltage law:

$$-i(t)R - v_c(t) = v_i(t)$$

$$\Rightarrow i(t) = -\left[v_i(t) + v_c(t)\right] \quad \cdots (1)$$

Relation between $i(t)$ & $v_c(t)$:

$$i(t) = C\frac{dv_c(t)}{dt} \quad \cdots (2)$$

Substituting (2) in (1):

$$v_c(t) + RC\frac{dv_c(t)}{dt} = -v_i(t)$$

Taking Laplace transform both sides:

$$V_c(s) + RCsV_c(s) = -V_i(s)$$

$$\Rightarrow V_c(s)\left[1 + RCs\right] = -V_i(s)$$

Also:

$$V_o(s) = V_c(s) \quad \cdots (3)$$

Substituting (3) in (2):

$$V_o(s) = -\frac{V_i(s)}{1 + RCs} \quad \cdots (4)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\frac{1}{1 + RCs}$$

Problem 2:

Find the Transfer function of the following RC circuit

Applying Kirchoff's voltage law:

$$-v_R(t) - v_i(t) = v_o(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_i(t) = v_o(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_i(s) = V_o(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Ls}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Ls + R}{Ls}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Ls + R}{Ls}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Ls + R}{Ls}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Ls} + 1\right]V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Ls} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Ls} + 1\right]$$

Problem 3:

Find the Transfer function of the following RC circuit

Applying Kirchoff's voltage law:

$$-v_R(t) - v_i(t) = v_o(t)$$

Also, we have:

$$v_R(t) = i(t)R$$

Substituting (1) in (2), we get:

$$-i(t)R - v_i(t) = v_o(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_i(s) = V_o(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 4:

Find the Transfer function of the following circuit

Applying KVL:

$$-i(t)R - v_c(t) = v_i(t)$$

$$\Rightarrow i(t) = -\left[v_i(t) + v_c(t)\right] \quad \cdots (1)$$

We know that:

$$i(t) = C\frac{dv_c(t)}{dt} \quad \cdots (2)$$

Substituting (2) in (1):

$$v_c(t) + RC\frac{dv_c(t)}{dt} = -v_i(t)$$

Taking Laplace transform both sides:

$$V_c(s) + RCsV_c(s) = -V_i(s)$$

$$\Rightarrow V_c(s)\left[1 + RCs\right] = -V_i(s)$$

Also:

$$V_o(s) = V_c(s) \quad \cdots (3)$$

Substituting (3) in (2):

$$V_o(s) = -\frac{V_i(s)}{1 + RCs} \quad \cdots (4)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\frac{1}{1 + RCs}$$

Problem 5:

Find the Transfer function of the following circuit

Applying KVL:

$$-i(t)R - v_c(t) = v_i(t)$$

$$\Rightarrow i(t)R = -\left[v_i(t) + v_c(t)\right]$$

We know that:

$$i(t) = C\frac{dv_c(t)}{dt} \quad \cdots (1)$$

Substituting (1) in (2):

$$v_c(t) + RC\frac{dv_c(t)}{dt} = -v_i(t)$$

Taking Laplace transform both sides:

$$V_c(s) + RCsV_c(s) = -V_i(s)$$

$$\Rightarrow V_c(s)\left[1 + RCs\right] = -V_i(s)$$

Also:

$$V_o(s) = V_c(s) \quad \cdots (3)$$

Substituting (3) in (2):

$$V_o(s) = -\frac{V_i(s)}{1 + RCs} \quad \cdots (4)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\frac{1}{1 + RCs}$$

Problem 6:

Find the Transfer function of the following RLC circuit

Applying KVL:

$$-v_R(t) - v_c(t) - v_L(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) - v_L(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) - V_L(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs} + \frac{V_i(s)}{Ls}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]$$

Problem 7:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 8:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 9:

Find the Transfer function of the following RLC circuit

Applying KVL:

$$-v_R(t) - v_c(t) - v_L(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) - v_L(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) - V_L(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs} + \frac{V_i(s)}{Ls}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]$$

Problem 10:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 11:

Find the Transfer function of the following RLC circuit

Applying KVL:

$$-v_R(t) - v_c(t) - v_L(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) - v_L(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) - V_L(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs} + \frac{V_i(s)}{Ls}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{LCs^2 + Ls + R}{LCs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{LCs^2 + Ls + R}{LCs}\right]$$

Problem 12:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 13:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 14:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 15:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 16:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 17:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 18:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 19:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 20:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 21:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 22:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 23:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 24:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 25:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 26:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 27:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 28:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(s) = V_i(s)$$

$$\Rightarrow -\left[\frac{V_i(s)}{R} + \frac{V_i(s)}{Cs}\right]R = V_o(s)$$

$$\Rightarrow -\left[\frac{Cs + R}{Cs}\right]V_i(s) = V_o(s)$$

Taking Laplace transform both sides:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s) \quad \cdots (3)$$

Substituting (3) in (2), we get:

$$V_o(s) = -\frac{Cs + R}{Cs}V_i(s)$$

$$\Rightarrow V_o(s) = -\left[\frac{R}{Cs} + 1\right]V_i(s)$$

Transfer function:

$$\frac{V_o(s)}{V_i(s)} = -\left[\frac{R}{Cs} + 1\right]$$

Problem 29:

Find the Transfer function of the following circuit

Applying KVL:

$$-v_R(t) - v_c(t) = v_i(t)$$

Also:

$$v_R(t) = i(t)R$$

Substituting (1) in (2):

$$-i(t)R - v_c(t) = v_i(t)$$

Taking Laplace transform both sides:

$$-I(s)R - V_c(