i) PI controller

$V_a = 0$

$I_1 + I_2 = 0$

$I_3 - I_2 = 0$

Current through the capacitor

$$I_c = c\frac{dV_c}{dt}$$

$$I_1 = \frac{V_c - V_a}{R_1} \quad (V_a = 0)$$

$$= \frac{V_c}{R_1}$$

$$I_2 = \frac{V_b - V_a}{R_2} \quad (V_a = 0) \qquad = \frac{V_b}{R_2}$$

$$I_3 = c\,d(V_{out_1} - V_b)$$

$$\frac{V_2}{R_1} + \frac{V_b}{R_2} = 0 \quad \text{—(i)}$$

$$c\frac{d(V_{out} - V_b)}{dt} - \frac{V_b}{R_0} = 0 \quad \text{—(a)}$$

from eq (i)

$$\frac{V_b}{R_2} = -\frac{V_e}{R_1}$$

$$V_b = -\frac{R_2}{R_1} V_c$$