SAGAR INSTITUTE OF RESEARCH AND TECHNOLOGY, Bhopal

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Designation: AP

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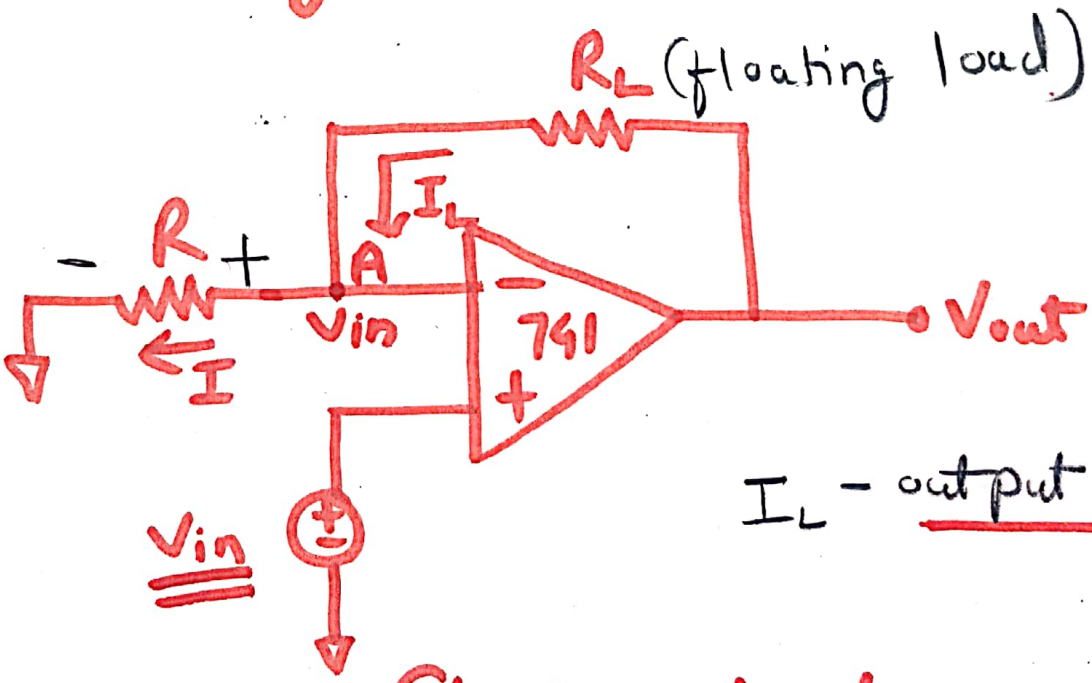
Subject: Analog Circuits EC 405

Voltage to current Converter (V to I)

- Application of op-amp
- 2 types

1) Voltage to current converter with floating load
2) Voltage to current converter with grounded load



I_L - output current

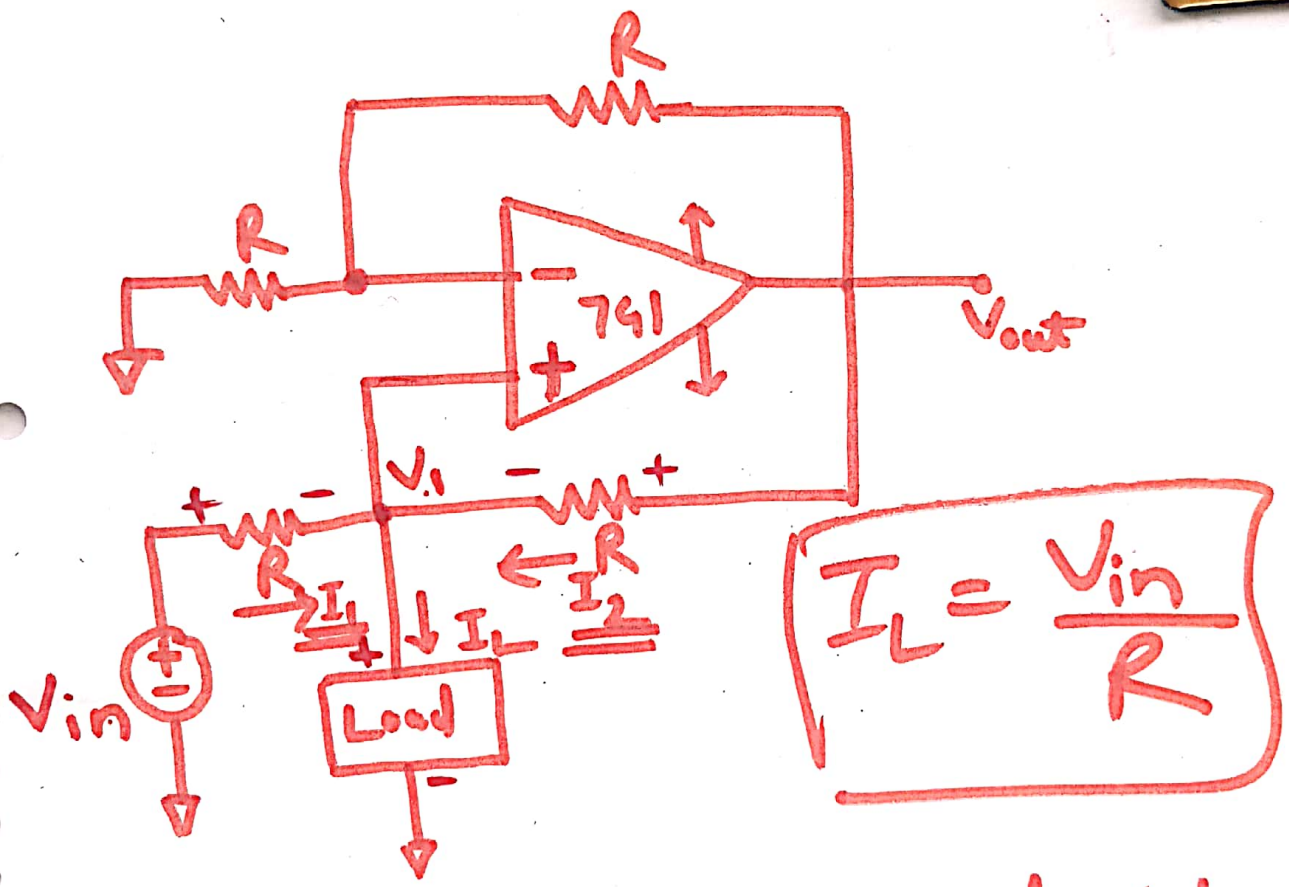
Floating load

Apply KCL

$$I = I_L$$

$$\boxed{\frac{V_{in}}{R} = I_L}$$

Voltage to current converter with grounded load



$$I_L = \frac{V_{in}}{R}$$

Apply KCL at node V_1

$$I_1 + I_2 = I_L$$

$$\frac{V_{in} - V_1}{R} + \frac{V_o - V_1}{R} = I_L$$

$$V_{in} + V_o - 2V_1 = I_L R$$

$$V_1 = \frac{V_{in} + V_o - I_L R}{2} \quad \text{--- (1)}$$

The op-amp is connected to non-inverting termind

$$A_{vf} = 1 + \frac{R_f}{R}$$

$$= 1 + \frac{1}{1}$$

$$= 2$$

$$A_v = \frac{V_o}{V_1}$$

$$\boxed{2V_1 = V_o} \quad \text{---} (2)$$

$$V_o = V_{in} + V_o - I_L R$$

$$V_{in} = I_L R$$

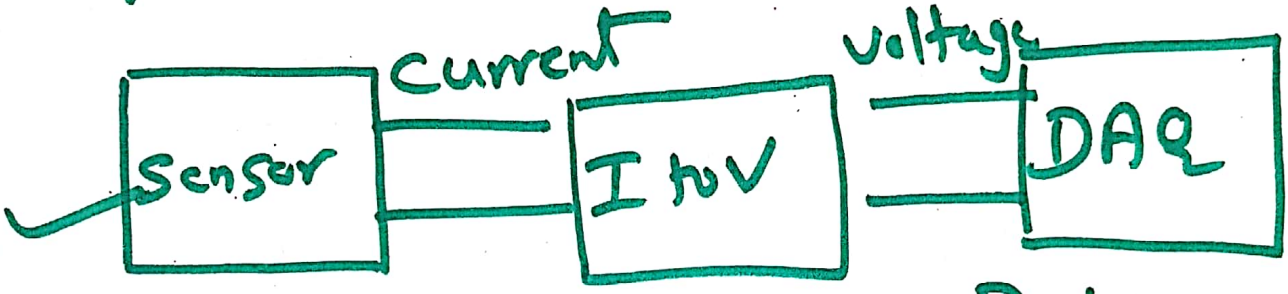
$$\boxed{I_L = \frac{V_{in}}{R_L}} \quad \text{---} (3)$$

Current to Voltage Converter
(I to V converter)

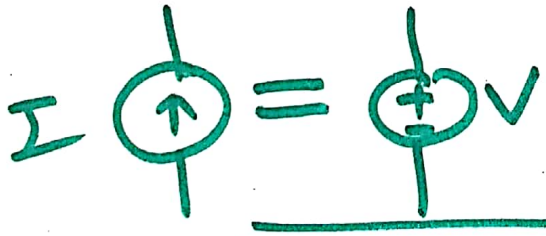
V ∝ I

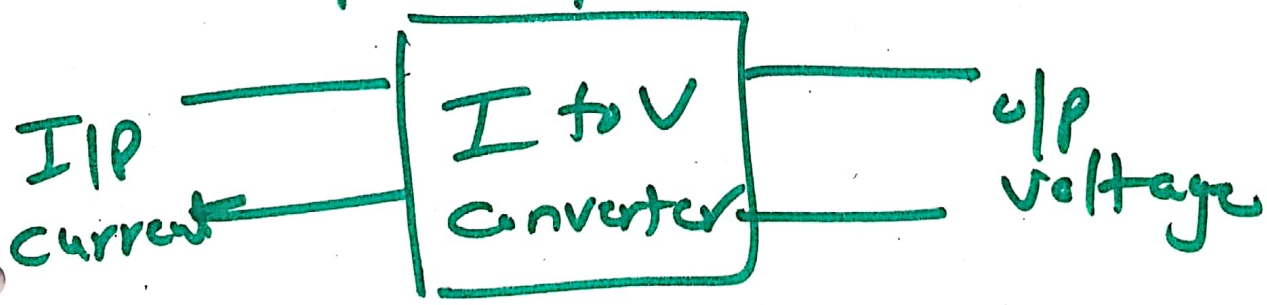
Need of Converter

Photodetector



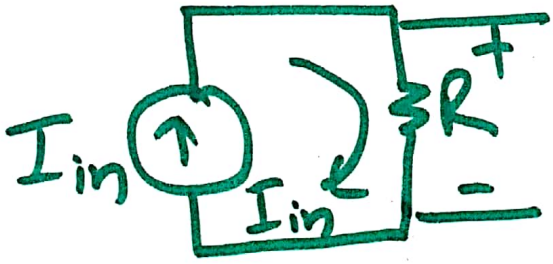
Data acquisition



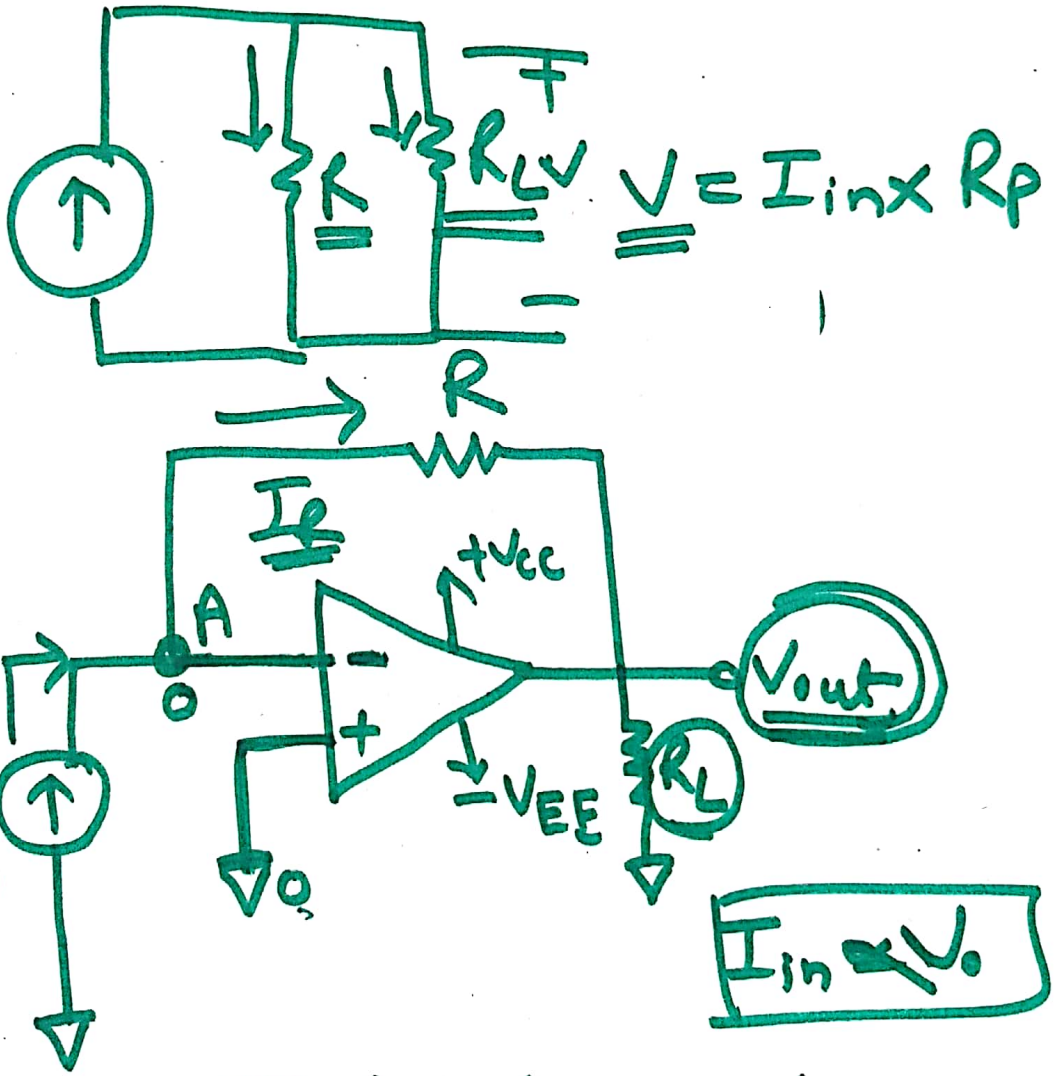


current controlled voltage source

Passive component



$V = I_{in} \times R$



$V = I_{in} \times R_p$

I to V Converter

Apply KCL

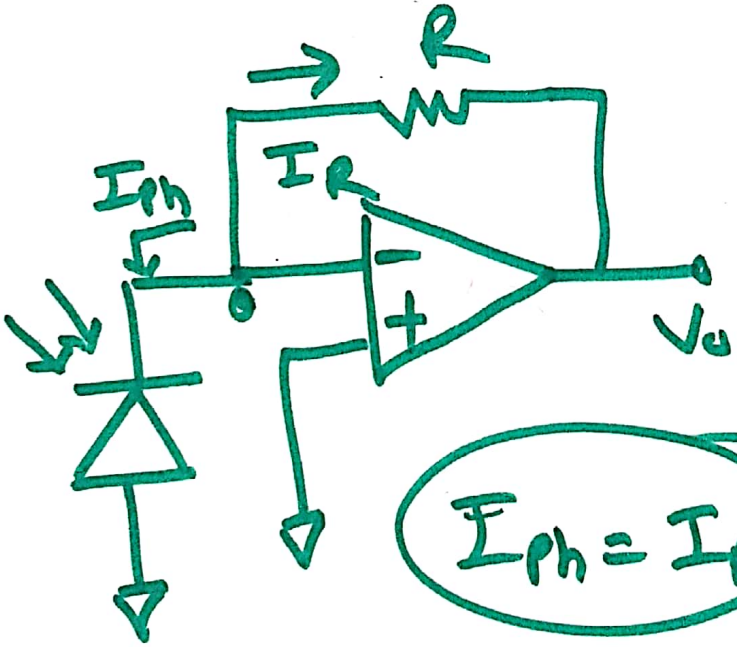
$I_{in} = I_R$

$= \frac{0 - V_o}{R}$

$$I_{in} = -\frac{V_o}{R}$$

$$V_o = -I_{in} \times R$$

$$\boxed{V_o \propto I_{in}}$$



$$I_{ph} = I_R$$

$$= 0 - V_o$$

$$\boxed{V_o = I_{Rh} \times R}$$

$$\boxed{V_o \propto I_{ph}}$$