

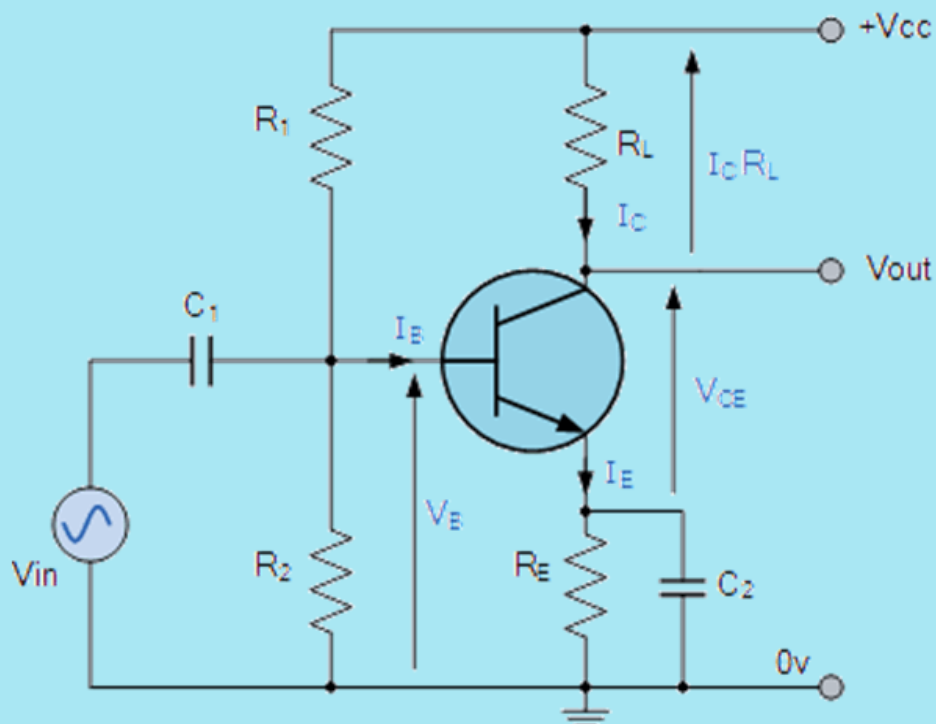
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## Physics Class 12 NCERT Solutions: Chapter 14 Semiconductor Electronics Materials Devices and Simple Circuits Part 2

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### Common Emitter Amplifier:



Q: 9. For a CE-Transistor amplifier, the audio signal voltage across the collector resistance of  $2k\Omega$  is  $2V$ . Suppose the current amplification factor of the transistor is  $100$ , find the input signal voltage and base current, if the base resistance is  $1k\Omega$ .

Answer:

Collector resistance,  $R_C = 2k\Omega = 2000\Omega$

Audio signal voltage across the collector resistance,  $V = 2V$

Current amplification factor of the transistor,  $\beta = 100$

Base resistance,  $R_B = 1k\Omega = 1000\Omega$

Input signal voltage  $= V_i$

Base current  $= I_B$

We have the amplification relation as:

$$\text{Voltage amplification} = \frac{V}{V_i} = \beta \frac{R_C}{R_B}$$

$$\begin{aligned} V_i &= \frac{V R_C}{\beta R_B} \\ &= \frac{2 \times 1000}{100 \times 2000} = 0.01V \end{aligned}$$

Therefore, the input signal voltage of the amplifier is  $0.01V$ .

Base resistance is given by the relation:

$$\begin{aligned} R_B &= \frac{V_i}{I_B} \\ &= \frac{0.01}{1000} = 10 \times 10^{-6} \mu A \end{aligned}$$

Therefore, the base current of the amplifier is  $10\mu A$ .

Q: 10. Two amplifiers are connected one after the other in series (cascaded). The first amplifier has a voltage gain of 10 and the second has a voltage gain of 20. If the input signal is 0.01 volt, calculate the output ac signal.

Answer:

Voltage gain of first amplifier,  $V_1 = 10$

Voltage gain of second amplifier,  $V_2 = 20$

Input signal voltage,  $V_i = 0.01V$

Output AC signal voltage  $= V_o$

The total voltage gain of a two-stage cascaded amplifier is given by the product of Voltage gains of both the stage, i.e.,

$$\begin{aligned} V &= V_1 \times V_2 \\ &= 10 \times 20 = 200 \end{aligned}$$

We have the relation:

$$\begin{aligned} V &= \frac{V_o}{V_i} \\ V_o &= V \times V_i \\ &= 200 \times 0.01 = 2V \end{aligned}$$

Therefore, the output AC signal of the given amplifier is  $2V$ .

Q: 11. A p-n photodiode is fabricated from a semiconductor with band gap of  $2.8 eV$ . Can it detect a wavelength of  $6000 nm$ ?

Answer:

Energy band gap of the given photodiode,  $E_g = 2.8 eV$

Wavelength,  $\lambda = 6000 nm = 6000 \times 10^{-9} m$

The energy of a signal is given by the relation:

$$E = \frac{hc}{\lambda}$$

Where,

$$h = \text{Planck's constant}$$

$$= 6.626 \times 10^{-34} \text{ J s}$$

$$C = \text{Speed of light}$$

$$= 3 \times 10^8 \text{ m/s}$$

$$E = \frac{6.626 \times 10^{-34} \times 3 \times 10^8}{6000 \times 10^{-9}}$$

$$= 3.313 \times 10^{-20} \text{ J}$$

$$\text{But } 1.6 \times 10^{-19} \text{ J} = 1 \text{ eV}$$

$$\therefore E = 3.313 \times 10^{-20} \text{ J}$$

$$= \frac{3.313 \times 10^{-20}}{1.6 \times 10^{-19}} = 0.207 \text{ eV}$$

The energy of a signal of wavelength  $6000 \text{ nm}$  is  $0.207 \text{ eV}$ , which is less than  $2.8 \text{ eV}$  – the energy band gap of a photodiode. Hence, the photodiode cannot detect the signal.