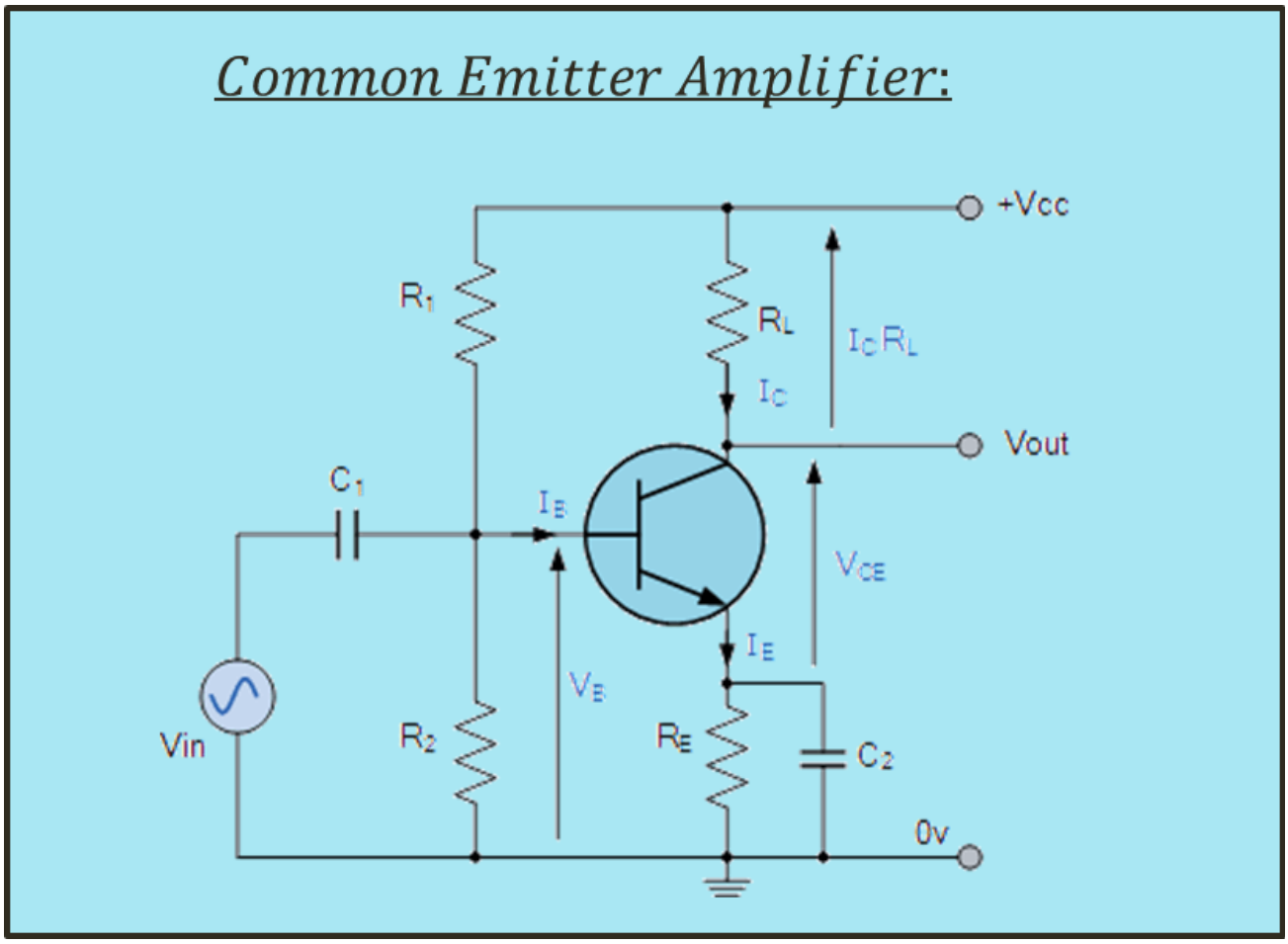
Physics Class 12 NCERT Solutions: Chapter 14 Semiconductor Electronics Materials Devices and Simple Circuits Part 2



Q: 9. For a CE-Transistor amplifier, the audio signal voltage across the collected 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, $Rc = 2k\Omega = 2000\Omega$

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 $= V_1$

Base current $= I_B$

We have the amplification relation as:

Voltage amplification $= \frac{V}{V_1} = \beta\frac{R_C}{R_B}$

$$V_i = \frac{VR_C}{\beta R_B}$$

$$= \frac{2 \times 1000}{100 \times 2000} = 0.01V$$

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

Base resistance is given by the relation:

$$R_B = \frac{V_i}{I_B}$$

$$= \frac{0.01}{1000} = 10 \times 10^{-6}\mu A$$

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.. ,

$$V = V_1 \times V_2$$

$$= 10 \times 20 = 200$$

We have the relation:

$$V = \frac{V_o}{V_i}$$

$$V_o = V \times V_i$$

$$= 200 \times 0.01 = 2V$$

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,

$h =$ Planck's constant

$= 6.626 \times 10^{-34} Js$

$C =$ Speed of light

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

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

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

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

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

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

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