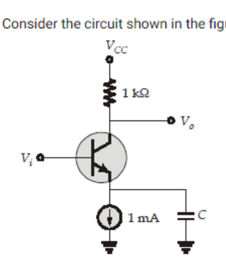
ANALOG CIRCUITS-2 (GATE - 2021) - REPORTS

OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) CORRECT(7) INCORRECT(4) SKIPPED(6)

Q. 1 ? FAQ Solution Video Have any Doubt ?

Consider the circuit shown in the figure below:



Suppose the bipolar transistor exhibits the following characters $I_C = I_s \exp\left(\frac{V_{BE}}{2V_T}\right)$. Assuming the β of the transistor to be very high on no early effect the value of small signal gain of the amplifier is equal to (Assume V_T = 25 mV)

A 20

B 40

C −20 — Correct Option

Solution :
(c)

$$g_m = \frac{\partial I_C}{\partial V_{BE}} = \frac{I_C}{2V_T} = \frac{1\times10^{-3}}{2\times25\times10^{-3}} = \frac{1}{50} = 20\ \text{mA/V}$$

$$\therefore \quad A_v = -g_m R_C = -20\ \text{mA/V} \times 1\ \text{k}\Omega = -20\ \text{V/V}$$

D −40 — Your answer is Wrong

QUESTION ANALYTICS +

Q. 2 ? FAQ Solution Video Have any Doubt ?

In a differential amplifier if the emitter resistance is replaced by an ideal current source then

A the differential gain of the amplifier is increased

B the common mode gain of the amplifier decreased — Your answer is Correct

Solution :
(b)

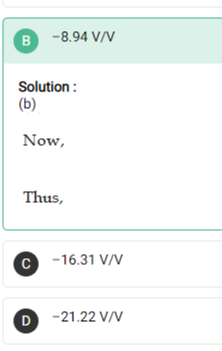
C the CMRR of the amplifier is reduced

D the CMRR of the amplifier remains unaffected

QUESTION ANALYTICS +

Q. 3 Solution Video Have any Doubt ?

Consider the circuit shown in the figure below:



The value of $\frac{\mu_n C_{ox} W}{L} = 1\ \text{mA/V},\ V_T = 2\ \text{V and } \lambda = 0.$ Then, the value of small signal voltage gain A_v is equal to

A −12.65 V/V

B −8.94 V/V — Your answer is Correct

Solution :
(b)

$$\text{Now,} \quad g_m = \sqrt{2\mu_n C_{ox}\frac{W}{L} I_{DS}} = \sqrt{2\times1\times10^{-3}\times0.4\times10^{-3}}$$

$$= 0.894\ \text{mA/V}$$

$$\text{Thus,} \quad A_v = -g_m R_D = -0.894 \times 10 = -8.94\ \text{V/V}$$

C −16.31 V/V

D −21.22 V/V

QUESTION ANALYTICS +

Q. 4 Solution Video Have any Doubt ?

Consider a two stage amplifier circuit shown in the figure below:

The transconductance of the transistor T_1 and T_2 are g_{m_1} and g_{m_2} respectively, then the overall transconductance $g_m = \frac{I_o}{V_i}$ is equal to

(Assume $\alpha_1 = \alpha_2 \approx 1$)

A $g_m \approx g_{m_1}$ — Your answer is Correct

Solution :
(a)

$$g_{m_1} = \frac{I_1}{V_i}$$

$$\text{Now,} \quad I_o = \frac{I_1}{\alpha} \approx I_1$$

$$\therefore \quad g_m = \frac{I_o}{V_i} \approx \frac{I_1}{V_i} = g_{m_1}$$

B $g_m \approx g_{m_1} + g_{m_2}$

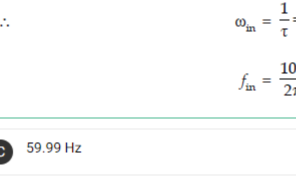
C $g_m = g_{m_2}$

D $g_m \approx g_{m_1} - g_{m_2}$

QUESTION ANALYTICS +

Q. 5 ? FAQ Solution Video Have any Doubt ?

Consider an ideal voltage amplifier shown in the figure below:



The value of input pole frequency is equal to

A 23.16 Hz

B 15.91 Hz — Your answer is Correct

Solution :
(b)

The capacitance at the input

$$C_{in} = C_1(1 + A_v) = 1 \times 10^{-9}(1 + 10^3)$$

$$C_{in} \approx 1 \times 10^{-6}\ \text{F}$$

$$\therefore \quad \tau = RC_{in} = 10 \times 10^3 \times 1 \times 10^{-6} = 10^{-2}$$

$$\therefore \quad \omega_{in} = \frac{1}{\tau} = 100\ \text{rad/sec}$$

$$f_{in} = \frac{100}{2\pi} = 15.91\ \text{Hz}$$

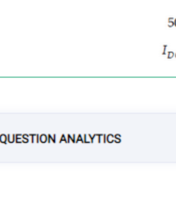
C 59.99 Hz

D 88.69 Hz

QUESTION ANALYTICS +

Q. 6 ? FAQ Solution Video Have any Doubt ?

Consider the circuit shown in the figure below:



The circuit is biased by an ideal current source with current I. The value of β for the transistor is very large and η = 1. If the small signal voltage gain for the transistor is equal to $|A_v| = 50$ and the output impedance is equal to 10 kΩ, then the value of DC biasing current I is equal to ____ μA. (Assume V_T = 26 mV)

130 — Your answer is Correct130

Solution :
130

Given: r_o = 10 kΩ

$$|A_v| = g_m r_o = \frac{I_C}{V_T} \cdot r_o$$

$$50 = \frac{I_C}{26\ \text{mV}} \times 10\ \text{k}\Omega$$

$$I_{DC} = 130\ \mu\text{A}$$

QUESTION ANALYTICS +

Q. 7 Solution Video Have any Doubt ?

An amplifier has open loop gain of $A_{OL} = 5 \times 10^3$. The amplifier is connected by the negative feedback with feedback factor β = 0.01. If the open loop gain of op-amp decreases by 10%, then the closed loop gain decreased by ______ %.

0.19 (0.18 - 0.25) — Correct Option

Solution :
0.19 (0.18 - 0.25)

$$\%\ \text{Change} = \frac{10\%}{1+5\times10^3\times10^{-2}} = \frac{10}{51}\% = 0.19\%$$

Your Answer is 0.48

QUESTION ANALYTICS +

Q. 8 ? FAQ Solution Video Have any Doubt ?

In a BJT common emitter amplifier,

A the blocking capacitance at the input is called as input coupling capacitor. — Your option is Correct

B the blocking capacitance at the output is called as output coupling capacitor. — Your option is Correct

C the blocking capacitance at the emitter is called as bypass capacitor. — Your answer is Wrong

D the capacitor that produces on A.C ground is called as bypass capacitor. — Your option is Correct

YOUR ANSWER - d,a,b,c | CORRECT ANSWER - a,b,d | STATUS - ✖

Solution :

QUESTION ANALYTICS +

Q. 9 Solution Video Have any Doubt ?

The desirable characteristics of a transconductance amplifier are

A high input resistance — Your option is Correct

B high output resistance — Your option is Correct

C low input resistance

D low output resistance

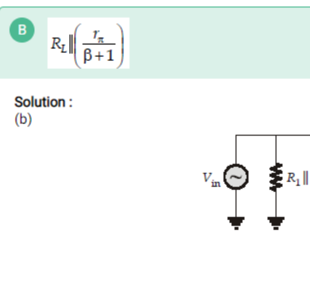
YOUR ANSWER - a,b | CORRECT ANSWER - a,b | STATUS - ✔

Solution :

QUESTION ANALYTICS +

Q. 10 Solution Video Have any Doubt ?

Consider the circuit shown in the figure below:

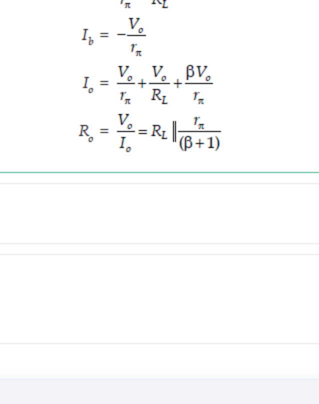


The amplifier has common emitter input resistance equal to r_π and current gain 'β', then the value of the output resistance R_{out} is equal to

A R_L

B $R_L \| \left(\frac{r_\pi}{\beta+1}\right)$ — Your answer is Correct

Solution :
(b)



$$I_o = \frac{V_o}{r_\pi} + \frac{V_o}{R_L} - \beta I_b$$

$$\text{and} \quad I_b = -\frac{V_o}{r_\pi}$$

$$\therefore \quad I_o = \frac{V_o}{r_\pi} + \frac{V_o}{R_L} + \frac{\beta V_o}{r_\pi}$$

$$\therefore \quad R_o = \frac{V_o}{I_o} = R_L \| \frac{r_\pi}{(\beta+1)}$$

C $R_L \| r_\pi$

D $\left(\frac{1}{R_L} \| \frac{1}{r_\pi}\right)^{-1}$

QUESTION ANALYTICS +

ANALOG CIRCUITS-2 (GATE - 2021) - REPORTS

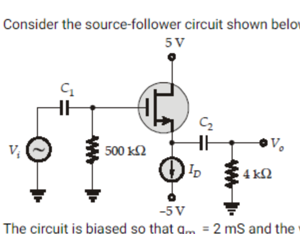
OVERALL ANALYSIS | COMPARISON REPORT | SOLUTION REPORT

ALL(17) CORRECT(7) INCORRECT(4) SKIPPED(6)

Q. 11

Solution Video | Have any Doubt ?

Consider the source-follower circuit shown below:



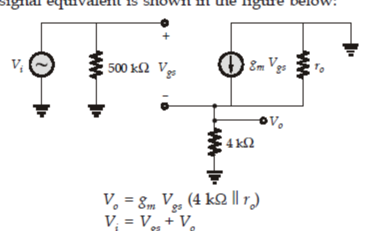
The circuit is biased so that g_m = 2 mS and the value of output resistance for MOS transistor r_o = 100 kΩ, then the value of small signal voltage gain $\frac{V_o}{V_i}$ is equal to

A 10

B −0.8 — Your answer is **Wrong**

C 0.8 — Correct Option

Solution :
(c)
The value of small signal equivalent is shown in the figure below:



Now, $\quad V_o = g_m V_{gs} (4\text{ k}\Omega \parallel r_o)$ ...(1)

Now, $\quad V_i = V_{gs} + V_o$

$$V_i = V_{gs} + g_m V_{gs} (4\text{ k}\Omega \parallel r_o)$$

$$V_{gs} = \frac{V_i}{1+g_m(4\text{ k}\Omega \parallel r_o)} \quad ...(2)$$

∴ Substituting (2) in (1) we get, $\frac{V_o}{V_i} = \frac{g_m(4\text{ k}\Omega \parallel r_o)}{1+g_m(4\text{ k}\Omega \parallel r_o)} = 0.8$

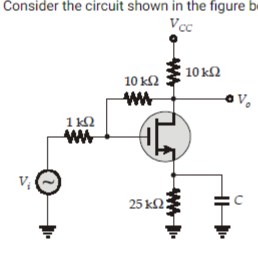
D −0.9

QUESTION ANALYTICS +

Q. 12

? FAQ | Solution Video | Have any Doubt ?

Consider the circuit shown in the figure below:



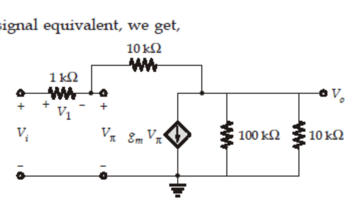
the value of r_{ds} = 100 kΩ and the circuit is biased such that g_m = 5 mS, then the value of $\frac{V_o}{V_s}$ is equal to

A −1.15

B −15.24

C −6.79 — Correct Option

Solution :
(c)
Drawing the small signal equivalent, we get,



$$V_\pi = V_i - V_1$$

$$V_1 = \frac{-1\text{ k}\Omega\,(V_o - V_i)}{1\text{ k}\Omega + 10\text{ k}\Omega} = \frac{V_i - V_o}{11}$$

$$V_\pi = V_i - (V_i - V_o)\times\frac{1}{11} = \frac{10V_i + V_o}{11}$$

Applying KCL, we get,

$$\frac{V_o}{10\text{ k}\Omega} + \frac{V_o}{100\text{ k}\Omega} + \frac{V_o - V_\pi}{10\text{ k}\Omega} + g_m V_\pi = 0$$

$$\frac{V_\pi - V_o}{10\text{ k}\Omega} = \frac{V_o}{10\text{ k}\Omega} + \frac{V_o}{100\text{ k}\Omega} + \frac{5}{10^3}V_\pi$$

$$10(V_\pi - V_o) = 10V_o + V_o + 500V_\pi$$

$$21V_o = -490\,V_\pi$$

$$\frac{-21}{490}V_o = \frac{10V_i + V_o}{11}$$

$$\frac{-21}{490}V_o - \frac{V_o}{11} = \frac{10V_i}{11}$$

$$\frac{-103}{770}V_o = \frac{10V_i}{11}$$

$$\frac{V_o}{V_i} = -\frac{700}{103} = -6.79$$

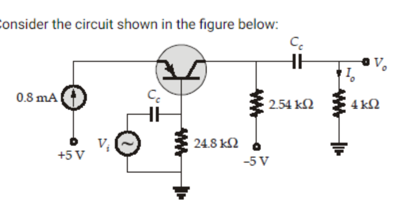
D −29.15

QUESTION ANALYTICS +

Q. 13

Solution Video | Have any Doubt ?

Consider the circuit shown in the figure below:



The transistor has β = 65 and r_0 = 95.2 kΩ then the value of transconductance $G = \frac{I_o}{V_i}$ is equal to

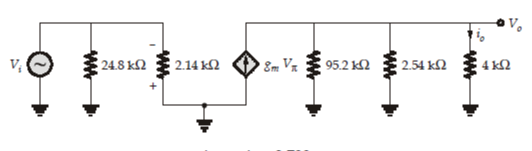
(Assume V_T = 26 mV)

A −5.96 mA/V

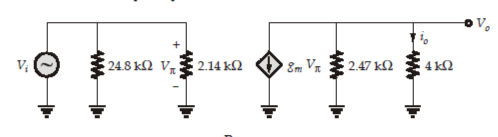
B −20.15 mA/V

C −11.6 mA/V — Correct Option

Solution :
(c)



$$g_m = \frac{i_c}{V_T} = \frac{\alpha i_e}{V_T} = \frac{0.788}{0.026} = 30.3\text{ mA/V}$$



$$i_o = \frac{R_1}{R_1+4}\,g_m V_\pi$$

At input terminal, we have,

$$V_\pi = -V_o$$

So, we obtain,

$$i_o = -\frac{2.47}{2.47+4}\times 30.3\times10^{-3}\,V_o$$

$$G_v = \frac{i_o}{V_o} = -\frac{2.47}{6.47}\times 30.3 = -11.6\text{ mA/V}$$

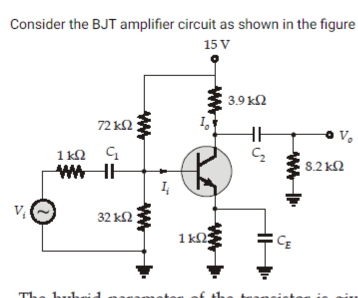
D −15.5 mA/V

QUESTION ANALYTICS +

Q. 14

Solution Video | Have any Doubt ?

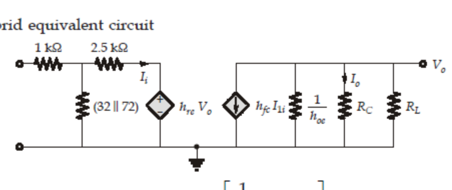
Consider the BJT amplifier circuit as shown in the figure below:



The hybrid parameter of the transistor is given as h_{fe} = 75, h_{ie} = 2.5 kΩ, h_{re} = 2.2 × 10^{-4} and h_{oe} = 20 μS. The small signal current gain $\frac{I_o}{I_i}$ for the circuit in the midband region is ________.

48.27 (45 - 50) — Correct Option

Solution :
48.27 (45 - 50)
Drawing hybrid equivalent circuit



$$I_o = h_{fe} I_i \left[\frac{\frac{1}{h_{oe}} \parallel R_C \parallel R_L}{R_C}\right]$$

$$\frac{I_o}{I_i} = 75\left[\frac{1}{3.9\left(\frac{1}{50}+\frac{1}{3.9}+\frac{1}{8.2}\right)}\right]$$

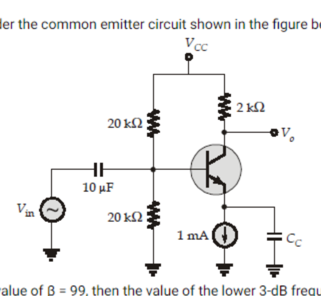
$$\frac{I_o}{I_i} = 48.27$$

QUESTION ANALYTICS +

Q. 15

Solution Video | Have any Doubt ?

Consider the common emitter circuit shown in the figure below:



If the value of β = 99, then the value of the lower 3-dB frequency is ______ Hz.
(Assume V_T = 25 mV)

7.95 (7 - 9) — Correct Option

Solution :
7.95 (7 - 9)
The input resistance,

$$r_\pi = \frac{V_T}{I_B} = \frac{\beta V_T}{I_C} = \frac{(\beta+1)V_T}{I_E}$$

$$= \frac{100\times25\times10^{-3}}{1\times10^{-3}} = 2.5\text{ k}\Omega$$

∴ $\quad R_{in} = (20\text{ k}\Omega \parallel 20\text{ k}\Omega \parallel 2.5\text{ k}\Omega) = 2\text{ k}\Omega$

∴ $\quad f = \frac{1}{2\pi R_{eq} C_{in}} = \frac{1}{2\pi\times10\times10^{-6}\times2\times10^{3}} = 7.95\text{ Hz}$

QUESTION ANALYTICS +

Q. 16

? FAQ | Solution Video | Have any Doubt ?

A transistor amplifier circuit parameter at $I_C = 2$ mA has inner capacitance (emitter-base capacitance) C_μ = 1 pF, C_π = 10 pF, β = 150 and V_T = 25 mV. Then,

A the value of unity current gain cut-off frequency f_T is equal to 1.56 GHz

B the value of $f_\beta > f_T$.

C the value of f_α is equal to 1.165 GHz. — Correct Option

D the value of $f_\alpha > f_T$. — Correct Option

YOUR ANSWER - NA | CORRECT ANSWER - c,d | STATUS - SKIPPED

Solution :
(c, d)

$$g_m = \frac{I_C}{V_T} = \frac{2\text{ mA}}{25\text{ mV}} = 80\times10^{-3}\text{ A/V}$$

So, we obtain the unity gain frequency

$$f_T = \frac{g_m}{2\pi(C_\mu + C_\pi)} = \frac{80\times10^{-3}}{2\pi(11)\times10^{-12}} = 1.157\text{ GHz}$$

$$f_\beta = \frac{f_T}{\beta} = 7.713\text{ MHz}$$

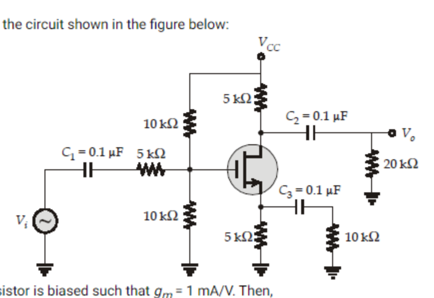
$$f_\alpha = f_T \times \alpha = 1.165\text{ GHz}$$

QUESTION ANALYTICS +

Q. 17

? FAQ | Solution Video | Have any Doubt ?

Consider the circuit shown in the figure below:



The transistor is biased such that g_m = 1 mA/V. Then,

A the 3-dB cut-off frequency due to capacitor C_1 is equal to 1 Krad/sec. — Correct Option

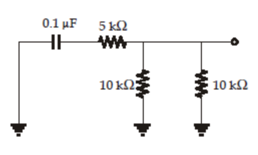
B the 3-dB cut-off frequency due to capacitor C_2 is equal to 40 Krad/sec.

C the 3-dB cut-off frequency due to capacitor C_3 is equal to 0.923 rad/sec.

D the 3-dB cut-off frequency of the amplifier due to capacitor C_3 is 923 rad/sec. — Correct Option

YOUR ANSWER - NA | CORRECT ANSWER - a,d | STATUS - SKIPPED

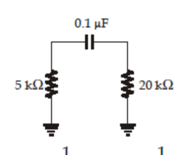
Solution :
(a,d)
For the C_1,



∴ $\quad \omega = \frac{1}{R_{eq}C}$ when R_{eq} = 5 kΩ + 10 kΩ || 10 kΩ

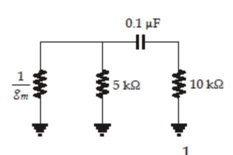
∴ $\quad \omega_1$ = 1 Krad/sec

For capacitor C_2



∴ $\quad \omega_2 = \frac{1}{R_2 C} = \frac{1}{25\times10^{3}\times0.1\times10^{-6}} = 400\text{ rad/sec}$

For capacitor C_C, we have,



∴ $\quad \omega_3 = \frac{1}{(1\text{ k}\Omega \parallel 5\text{ k}\Omega + 10\text{ k}\Omega)\times0.1\times10^{-6}}$

∴ $\quad \omega_3$ = 923 rad/sec

QUESTION ANALYTICS +

Item 11-17 of 17 « previous 1 2 next »