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328453 (28)

BE (4th Semester)

Examination, Nov.-Dec., 2021

Branch : Et & T

ANALOG ELECTRONICS (NEW)

Time Allowed : Three Hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Part (a) of each question is compulsory. Attempt any two parts from part (b), (c) & (d) of each question. Part (a) is of 2 marks and Part (b), (c) & (d) are of 7 marks each. Symbols have their usual meanings.

Q. 1. (a) What is biasing problem in a common collector circuits and how this problem is overcome ? (In brief).

(b) The transistor amplifier shown in figure (1) uses a transistor whose h-parameters are given as :

h_{ie} = 1.1 K, h_{fe} = 50, $h_{re} = 2.5 \times 10^{-4}$ and h_{oe} = 24 μA/V. Calculate $A_I = Io/I_i$, A_v, A_{vs}, and R_i.

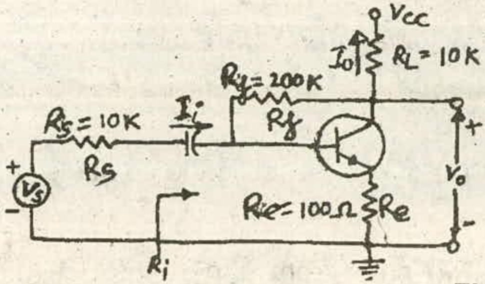

Figure (1)

(c) For the circuit shown in figure (2), verify that the modified h-parameters are :

$$h'_{ie} = h_{ie} + \frac{(1+h_{fe})R_e}{1+h_{oe}R_e} \text{ and } h'_{re} = \frac{h_{re} + h_{oe}\ R_e}{1+h_{oe}R_e}$$

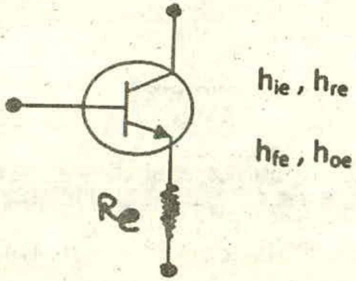

Figure (2)

(d) What is a Darlington pair ? Write its main characteristics. Derive expression for current gain A_I and input resistance R_i for a Darlington Pair.

Q. 2. (a) Why h-parameter model is not used to model BJT at high frequencies ?

(b) For hybrid-π model derive expression for :

- conductance $g_{b'e}$
- feedback conductance $g_{b'c}$
- base spreading resistance $r_{bb'}$

- output conductance g_{ce}; in terms of h-parameters

(c) The hybrid-π parameter of the transistor used in the circuit shown in figure (3) are $g_m = 50$ mA/V, $r_{b'e} = 1$ KΩ, $r_{b'c} = 4$ MΩ, $r_{ce} = 80$ KΩ, $C_c = 3$ pF, $C_e = 100$ pF and $r_{bb'} = 100$ Ω. Find (i) Upper 3 dB frequency of current gain $A_i = I_L/I_i$ (ii) The value of voltage gain $|A_{vs}| = |V_0/V_s|$ at frequency of part (i).

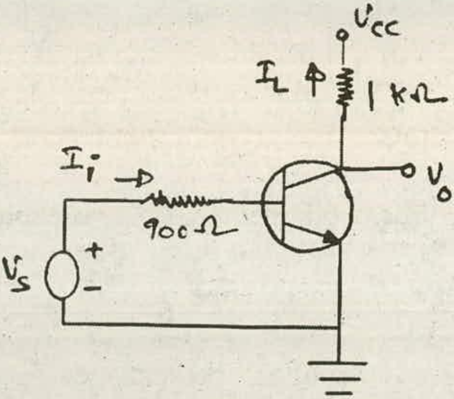

Figure (3)

(d) Derive the expression for CE gain-bandwidth product for voltage and current is respectively, as :

$$|A_{Vso}f_{HV}| = \frac{f_T}{1+2\pi f_T C_C R_L} \frac{R_L}{(R_s + T_{bb'})}$$

$$|A_{Iso}f_{HI}| = \frac{f_T}{1+2\pi f_T C_C R_L} \frac{R_S}{(R_s + T_{bb'})}$$

Q. 3. (a) The dynamic transfer characteristic curve for a given transistor is :

i_C (in mA) = $50\, i_b + 1000\, i_b^2$ where $i_b = 50 \cos 2\pi(100)t$ (in mA). Calculate the percent harmonic distortion.

(b) Calculate C_c for f_L = 15 Hz for circuit shown in figure (4).

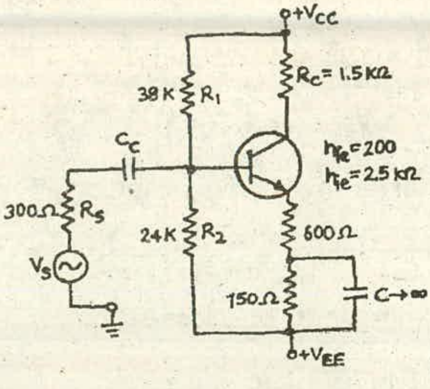

Figure (4)

(c) For the cascaded amplifier shown in figure (5), calculate the overall upper 3 dB frequency. Assume that the cascaded stages are non-interacting.

Figure (5)

Given $A_{v1} = \dfrac{A_{vo1}}{1 + \dfrac{s}{\omega_{H1}}}$ and $A_{v2} = \dfrac{A_{vo2}}{1 + \dfrac{s}{\omega_{H2}}}$

where A_{vo1} and A_{vo2} are midband gain of amplifier 1 and 2 respectively. $W_{H1} = 2\pi \times 100 \times 10^3$ rad/sec and $W_{H2} = 2\pi \times 500 \times 10^3$ rad/sec and S = jw.

(d) What is harmonic distortion ? How even harmonics are eliminated by Push-Pull arrangement of class-A power amplifier ? Explain with circuit diagram.

Q. 4. (a) An amplifier having an open-loop gain of 100 is connected in a negative feedback configuration with a feedback factor of 0.1, what is the closed loop gain of the amplifier ?

(b) Show that bandwidth of an amplifier increases by employing negative feedback.

(c) For the circuit shown in figure (6), $A = -1000$, $\beta = V_f/V_0 = 1/100$, $R_s = R_e = R_c = 1\ k\Omega$, $h_{ie} = 1\ k\Omega$, $h_{fe} = 100$ and h_{re}, h_{oe} are negligible. Find (i) V_i as a function of V_s and V_f (Assume that the inverting amplifier input resistance is infinite.), (ii) $A_{vf} = V_0/V_s = A\,V_i/V_s$.

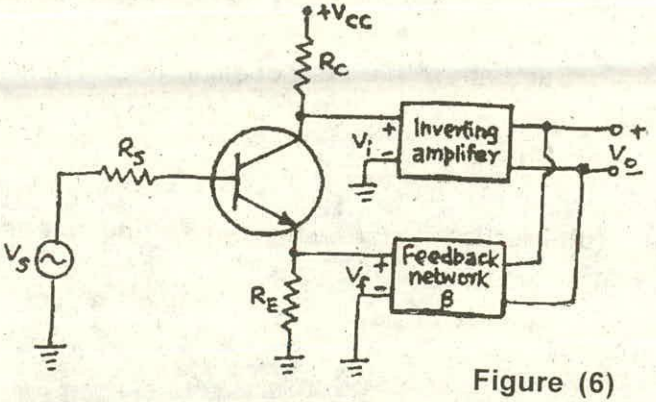

Figure (6)

(d) Derive the expression for input and output resistance (R_{if} and R'_{of}) with feedback for voltage series topology.

Q. 5. (a) Write Barkhausen criteria for oscillations.

(b) The gain of a forward amplifier is frequency dependent and given by $A = \left[\frac{-9 \times 10^6}{j\omega}\right]$. If the feedback fraction is $\left[\frac{6 \times 10^3}{(3 \times 10^3 + j\omega)^2}\right]$, find the frequency of oscillations.

(c) Draw basic circuit of Wein bridge oscillator and show that the condition for oscillation is $|A| \geq 3$.

(d) Discuss factors which affect the frequency stability of oscillators.