CMR
INSTITUTE OF
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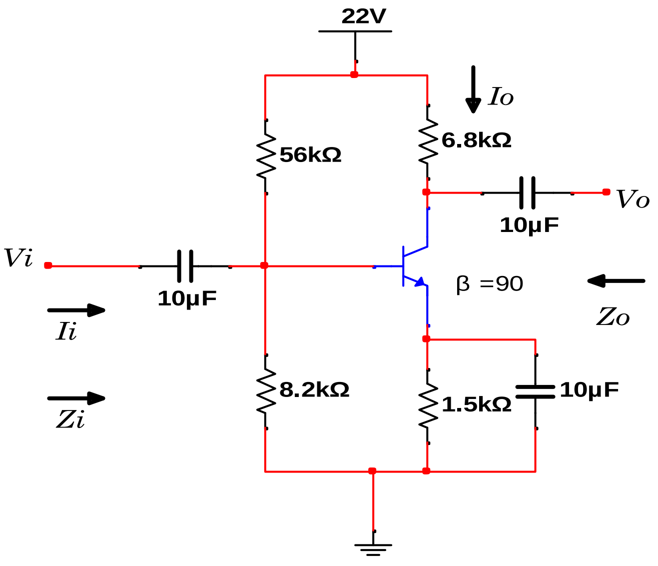
Internal Assesment Test - I

Sub:	Analog Electronics							Code:	15EC32
Date:	18 / 09 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	3rd	Branch:	ECE (C)

Answer Any FIVE FULL Questions

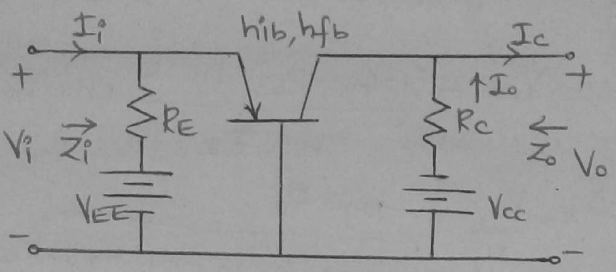
		Marks	OBE CO	OBE RBT
1 (a)	Analyze the Common base configuration with a circuit diagram.	[05]	CO1	L4
(b)	Obtain Z_i, Z_0, A_v and A_i for CB configuration using h-parameters.	[05]	CO1	L4
2	Apply the complete hybrid equivalent model, to determine the input impedance, output impedance, voltage gain and current gain of transistor amplifier in terms of h-parameters.	[10]	CO1	L3
3	Explain the BJT amplifier transistor modeling in detail.	[10]	CO1	L4
4	Draw the emitter follower configuration. Derive its input impedance, output impedance, voltage gain and current gain using h-parameters.	[10]	CO1	L3
5	Explain the Darlington Connection with a neat diagram. Analyze the Darlington connection DC bias condition using emitter follower configuration.	[10]	CO1	L4
6	For the network shown in the figure, calculate r_e, Z_i, Z_0 (r_0=∞ Ω) and A_v (r_0=∞ Ω.).	[10]	CO1	L3



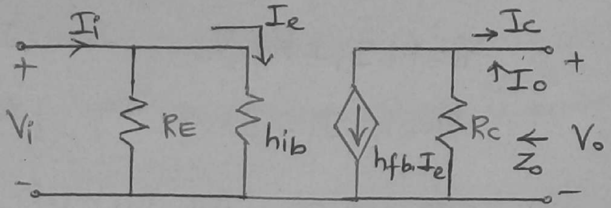
IAT-1 (Analog Electronics)

Solutions

1)
(a) Common-Base Configuration:



(b) CB configuration using h-parameters:



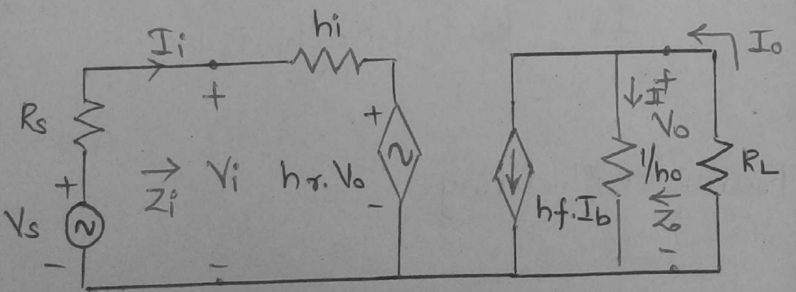
Input impedance, $Z_i = R_E \| h_{ib}$

Output impedance, $Z_o = R_C \| 1/h_{ob} \simeq R_C$

Voltage gain, $A_V = \frac{V_o}{V_i} = -\frac{R_C . h_{fb}}{h_{ib}}$

Current gain, $A_i = \frac{I_o}{I_i} = -h_{fb} = -1.$

2) Complete Hybrid Equivalent Model:



current gain, $A_i = \frac{I_o}{I_i}$ Apply KCL to the output

$I_o = h_f \cdot I_b + I$

$I_o = h_f \cdot I_b - h_o . I_o . R_L$

$A_i = \frac{I_o}{I_i} = \frac{h_{fe}}{1 + h_o . R_L}$

Voltage gain, $A_v = \frac{V_o}{V_i}$

$$V_i = h_i \cdot I_i + h_r \cdot V_o$$

$$I_i = (1 + h_o \cdot R_L) / I_o h_f, \quad I_o = -V_o / R_L$$

$$V_i = -\frac{(1 + h_o \cdot R_L) \cdot h_i \cdot V_o}{h_f \cdot R_L} + h_r \cdot V_o$$

$$A_v = \frac{V_o}{V_i} = \frac{-h_f \cdot R_L}{h_i + (h_i h_o - h_f \cdot h_r) \cdot R_L}$$

Input impedance, $Z_i = \frac{V_i}{I_i}$

$$V_i = h_i \cdot I_i + h_r \cdot V_o \qquad V_o = -I_o \cdot R_L$$

$$V_i = h_i \cdot I_i - I_o \cdot R_L \cdot h_r \qquad A_i = \frac{I_o}{I_i}$$

$$V_i = h_i \cdot I_i - A_i \cdot I_i \cdot h_r \cdot R_L$$

$$Z_i = \frac{V_i}{I_i} = h_i - \frac{h_f \cdot h_r \cdot R_L}{1 + h_o \cdot R_L}$$

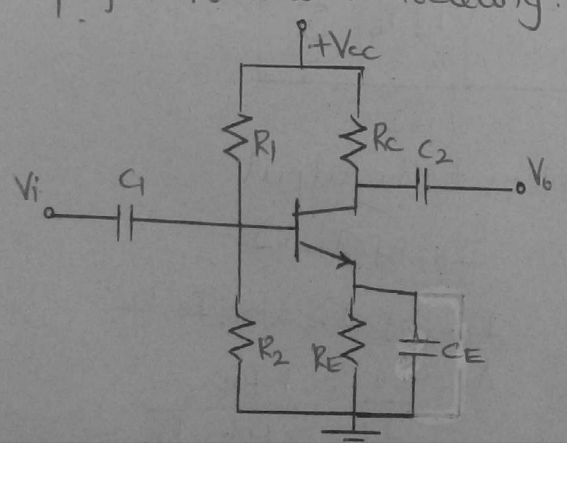
Output impedance, $Z_o = \frac{V_o}{I_o}$

When $V_s = 0$, $\quad I_i = \frac{-h_r \cdot V_o}{R_s + h_i}$

$$I_o = h_f \cdot I_i + h_o \cdot V_o$$

$$Z_o = \frac{V_o}{I_o} = \frac{1}{h_o - [h_f \cdot h_r / h_i + R_s]}$$

3. BJT Amplifier Transistor Modeling:



Modeling - approximates the actual behavior of semiconductor.

3 types (1) hybrid equivalent - approximation based on datasheet.

(2) r_e model - actual operating conditions.

(3) hybrid pi model - Feedback effect.

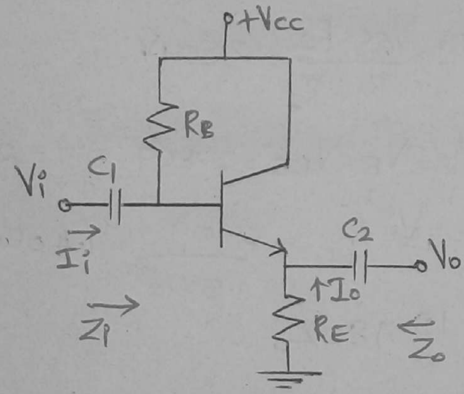
- The ac equivalent of a transistor network

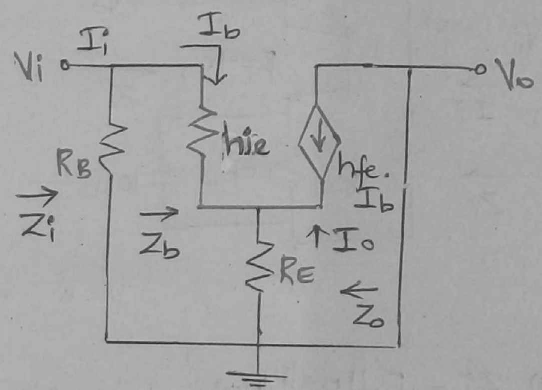
(1) Setting all dc sources to zero

(2) Replacing all capacitors by a short circuit.

(3) Redraw the network.

4) Emitter-follower Configuration using h-parameters





Input impedance, $Z_i = R_B \| Z_b$ $\quad Z_b = h_{ie} + h_{fe} . R_E$

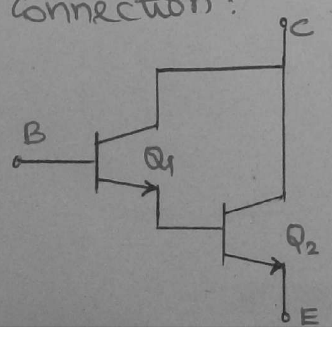
$Z_b \simeq h_{fe} . R_E$

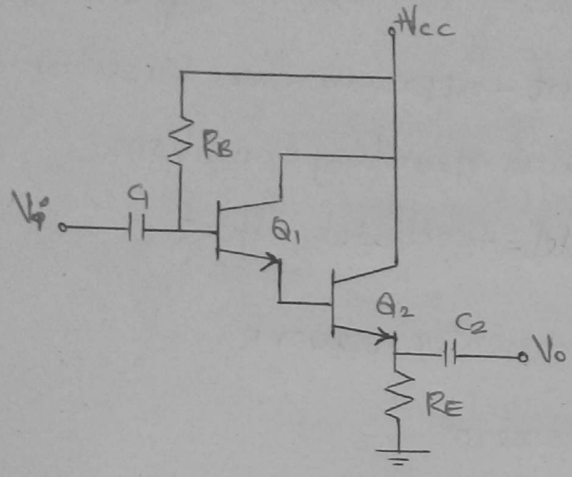
Output impedance, $Z_o = R_E \| h_{ie}/h_{fe}$

Voltage Gain, $A_V = \dfrac{V_o}{V_i} = \dfrac{R_E}{r_e + R_E}$

Current Gain, $A_i = \dfrac{I_o}{I_i} = h_{fe} . \dfrac{R_B}{R_B + Z_b}$

5) Darlington Connection:





$V_{cc} - I_{B1} \cdot R_B - V_{BE1} - V_{BE2} - I_{E2} \cdot R_E = 0$

$I_{E1} = \beta_1 \cdot I_{B1} = I_{B2}$

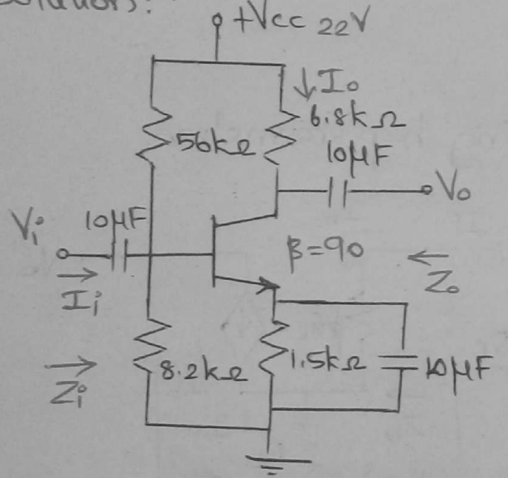
$I_{E2} = \beta_2 \cdot I_{B2} = \beta_2 \cdot \beta_1 \cdot I_{B1} = \beta_D \cdot I_{B1}$

$V_{cc} - V_{BE1} - V_{BE2} = I_{B1}[R_B + \beta_D \cdot R_E]$

$$I_{B1} = \frac{V_{cc} - V_{BE1} - V_{BE2}}{R_B + \beta_D \cdot R_E}$$

$V_{CE2} = V_{cc} - I_{E2} \cdot R_E$

6) Solution:



a) $r_e = \frac{26mV}{I_E}$

$V_B = \frac{V_{cc} \cdot R_2}{R_1 + R_2} = 2.809V$

$V_E = V_B - V_{BE} = 2.809 - 0.7 = 2.109V$

$I_E = V_E / R_E = \frac{2.109}{1.5 \times 10^3} = 1.406mA$

$r_e = 18.48\ \Omega$

b) $Z_i = R_1 \| R_2 \| \beta r_e$ $\qquad \beta r_e = 1663.53$

$= 1.349k\Omega$

c) $Z_o = R_c = 6.8k\Omega$

d) $A_v = \frac{V_o}{V_i} = -\frac{R_c}{r_e} = -\frac{6.8k\Omega}{18.48} = -366.972$

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