Benha University
Faculty of Engineering at Shoubra
Electrical Engineering Department
Third Year (Computer)

Make Up Exam (Spring 2016)
Date: (25/5/2016)
Subject: Electronic Circuits (1)
Duration: 3 hours

- **Answer all the following questions**
- **No. of questions : 4**
- **Total Mark: 80 Marks**

Model Answer

Question (1) (10Marks)

Choose the correct answer:

1- Which of the h-parameters corresponds to r_e in a common-base configuration?
  a. h_{rb} b. h_{fb} c. h_{ib} d. h_{ob}

2- For the common emitter amplifier, the output is from ……. .
  a. base b. emitter c. collector

3- The maximum efficiency of class A power amplifier is
  a. 10% b. 25% c. 45% d. 78%

4- Tuned Amplifier is class …. amplifier.
  a. A b. B c. C d. AB

5- In the h-model, hi represents…..
  a. Input resistance b. forward transfer current ratio c. output conductance

Question (2) (25 Marks)

1- Given IE=2.5mA, h_{fe}=140, h_{oe}=20uS and h_{ob}=0.5 uS, determine and sketch
  a. the common base r_e model
  b. the common emitter r_e model
  c. the common base hybrid equivalent circuit
  d. the common emitter hybrid equivalent circuit

Answer:

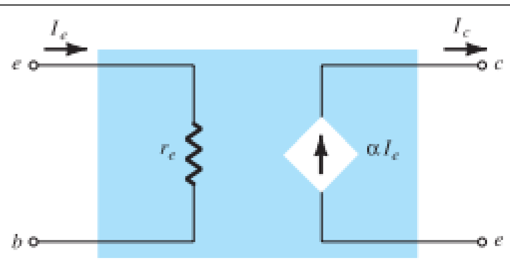
Use the following conversion formula

re=26mv/I_E= 26/2.5= 10.4 ohm

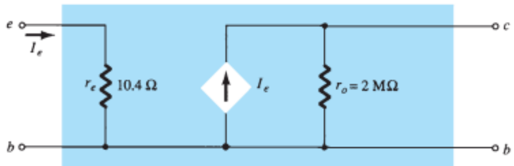
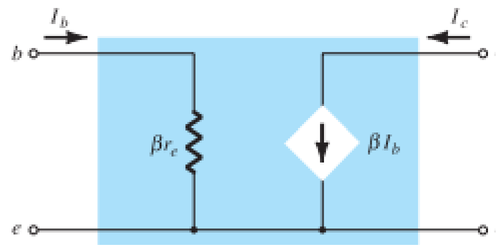
β= h_{fe}=140

βre=1.456 K ohm

Sketch the model with all parameters are now know



the common emitter r_e model

<table>
<tr>
<td>the common base r_e model
</td>
<td></td>
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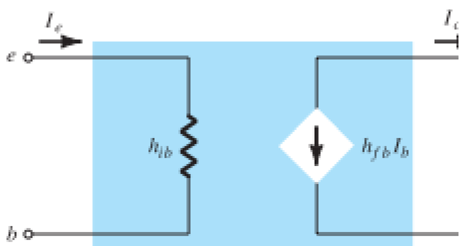
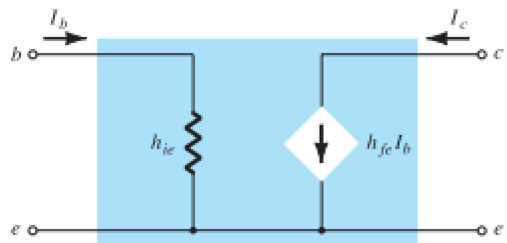
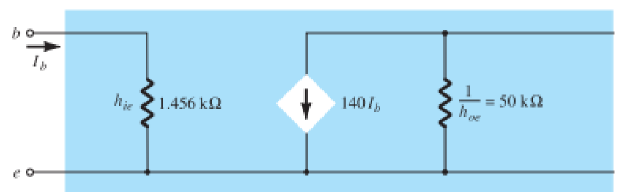
<td>the common base hybrid equivalent circuit
</td>
<td>the common emitter hybrid equivalent circuit

</td>
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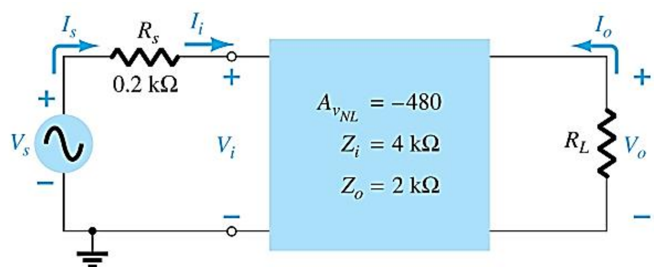
2- Given the packaged amplifier in the shown figure :

a. Determine the gain Av_L with R_L = 1.2 k ohm.

b. Determine Avs with R_L = 1.2 k ohm.

c. Find the current gain Ai with R_L = 5.6 k ohm.



Answer:

a. Eq. (5.89): $A_{v_L} = \frac{R_L}{R_L + R_o} A_{v_{NL}}$

$$= \frac{1.2\text{ k}\Omega}{1.2\text{ k}\Omega + 2\text{ k}\Omega}(-480) = (0.375)(-480)$$

$$= \mathbf{-180}$$

which is a dramatic drop from the no-load value.

b.

$$A_{v_s} = \frac{R_i}{R_i + R_s} \cdot \frac{R_L}{R_L + R_o} A_{v_{NL}}$$

$$= \frac{4\text{ k}\Omega}{4\text{ k}\Omega + 0.2\text{ k}\Omega} \cdot \frac{1.2\text{ k}\Omega}{1.2\text{ k}\Omega + 2\text{ k}\Omega}(-480)$$

$$= (0.952)(0.375)(-480)$$

$$= \mathbf{-171.36}$$

c.

$$A_{i_L} = \frac{I_o}{I_i} = \frac{I_o}{I_s} = -A_{v_L}\frac{Z_i}{R_L}$$

$$= -(-353.76)\left(\frac{4\text{ k}\Omega}{5.6\text{ k}\Omega}\right) = -(-353.76)(0.714)$$

$$= \mathbf{252.6}$$

Question (3)   (30 Marks)

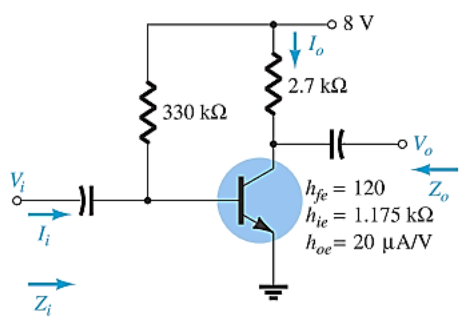
1- For the shown amplifier, determine

a. Z_i

b. Z_o

c. A_v

d. A_i



Answer:

a. $Z_i = R_B \| h_{ie} = 330\ \text{k}\Omega \| 1.175\ \text{k}\Omega$

$\cong h_{ie} = \mathbf{1.171\ k\Omega}$

b. $r_o = \dfrac{1}{h_{oe}} = \dfrac{1}{20\ \mu\text{A/V}} = 50\ \text{k}\Omega$

$Z_o = \dfrac{1}{h_{oe}} \| R_C = 50\ \text{k}\Omega \| 2.7\ \text{k}\Omega = \mathbf{2.56\ k\Omega} \cong R_C$

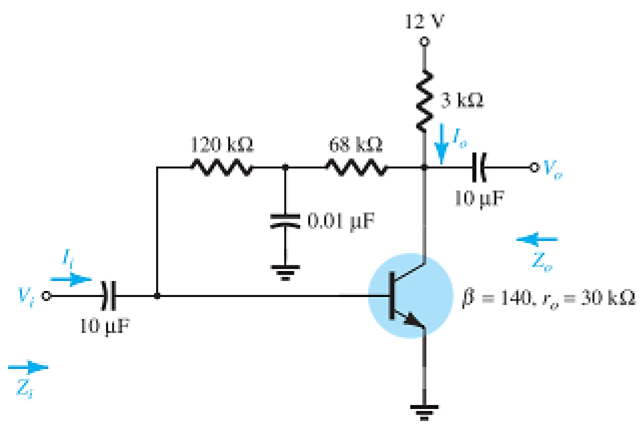
c. $A_v = -\dfrac{h_{fe}(R_C \| 1/h_{oe})}{h_{ie}} = -\dfrac{(120)(2.7\ \text{k}\Omega \| 50\ \text{k}\Omega)}{1.171\ \text{k}\Omega} = \mathbf{-262.34}$

d. $A_i \cong h_{fe} = \mathbf{120}$

2- For the shown amplifier network, determine

a. r_e

b. V_o if V_i=2mV.



Answer:

DC: $I_B = \dfrac{V_{CC} - V_{BE}}{R_F + \beta R_C}$

$= \dfrac{12\ \text{V} - 0.7\ \text{V}}{(120\ \text{k}\Omega + 68\ \text{k}\Omega) + (140)3\ \text{k}\Omega}$

$= \dfrac{11.3\ \text{V}}{608\ \text{k}\Omega} = 18.6\ \mu\text{A}$

$I_E = (\beta + 1)I_B = (141)(18.6\ \mu\text{A})$

$= 2.62\ \text{mA}$

$r_e = \dfrac{26\ \text{mV}}{I_E} = \dfrac{26\ \text{mV}}{2.62\ \text{mA}} = \mathbf{9.92\ \Omega}$

$$A_v \cong -\frac{R_{F_2} \| R_C}{r_e} = -\frac{68\text{ k}\Omega \| 3\text{ k}\Omega}{9.92\ \Omega}$$
$$\cong -\frac{2.87\text{ k}\Omega}{9.92\ \Omega}$$
$$\cong \mathbf{-289.3}$$
$$|A_v| = 289.3 = \frac{V_o}{V_i}$$
$$V_o = 289.3V_i = 289.3(2\text{ mV}) = \mathbf{0.579\ V}$$

Question (4) (15 Marks)

1- Compare between the small-signal amplifier and power amplifier.

small-signal amplifier	**power amplifier**
Use general purpose transistors	Use power transistors
Linearity is important	Efficiency is important
Doesn't need heat sink	Need heat sink
Provide large voltage gain	Provide large output current
Used as first stage in typical amplifier	Used in the output stage
Configurations are C.E, C.B and C.C	Classes are Class A, B, AB and C

2- For class A power amplifier, given I_{CQ}=30mA and V_{CEQ}=6.2V,Rc= 2K ohm calculate:

a. The maximum peak voltage swing $V_{c(max)}$.

b. The maximum output power $P_{out(max)}$.

c. The power dissipated by the transistor P_{DQ}.

Answer

a. $V_{c(max)} = I_{CQ} * Rc$= 30*2= 60V (very high value)

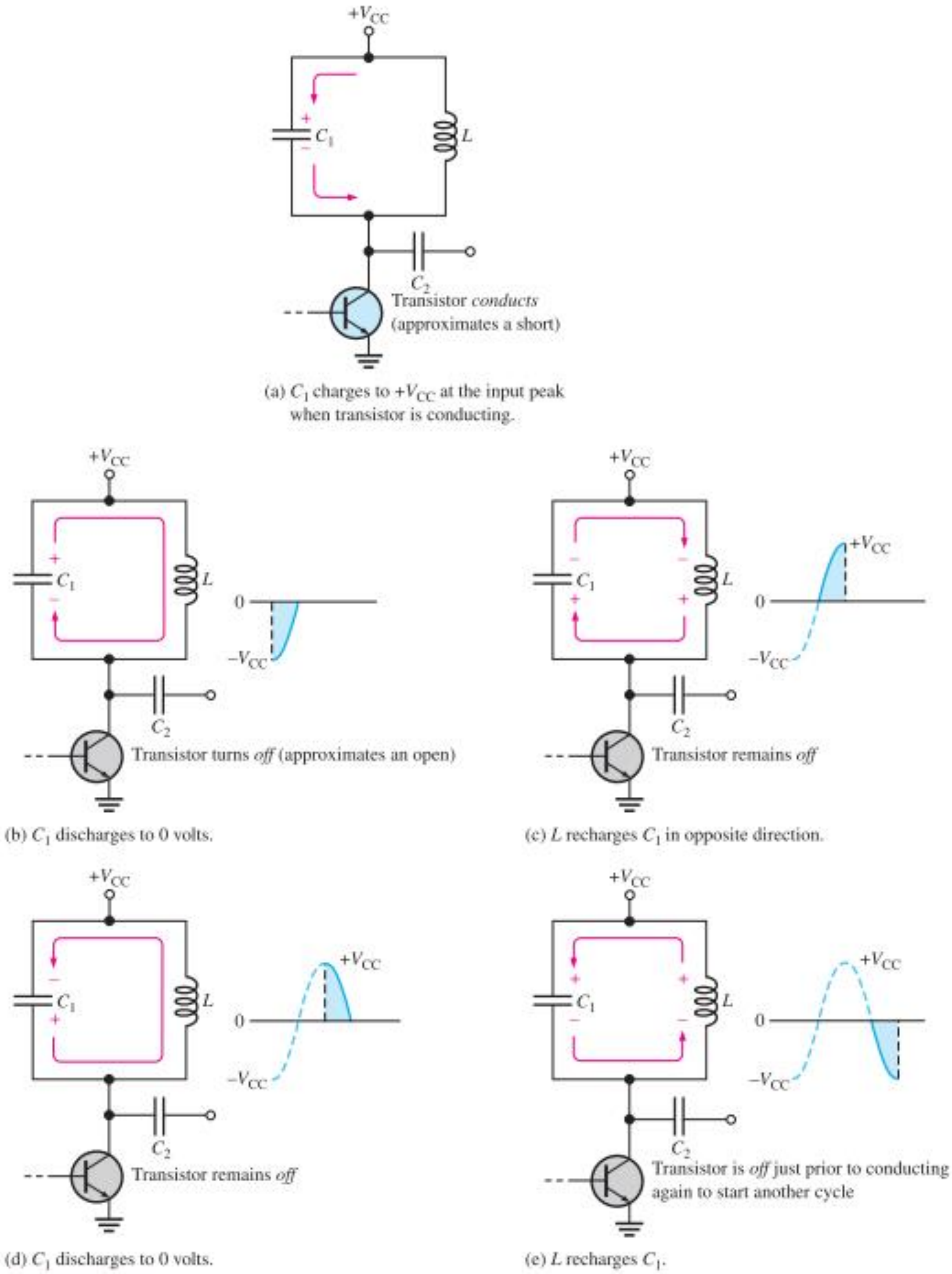
b. $P_{out(max)} = 0.5 * I_{CQ} * V_{CEQ}$ =0.5*30*6.2= 93 mW

c. $P_{DQ} = I_{CQ} * V_{CEQ}$ = 186 mW

3- Explain the tuned operation in class C amplifier.

Answer

The tuned operation happens within the resonant circuit and the action is as follows



▲ FIGURE 7–25

Resonant circuit action.

Good Luck,
Dr. Ahmad El-Banna