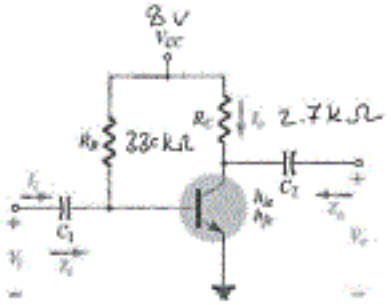
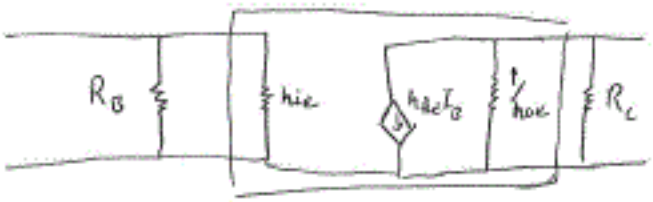
Question 3 (10 points)

Make a hybrid small signal equivalent model and find

a) Input Impedence
b) Ouput Impedence
c) Voltage gain

Solution





$h_{fe} = 120 = \beta$

$h_{ie} = 1.17\ k\Omega = \beta r_e$

$h_{oe} = 20\ \mu A/V$

$1/h_{oe} = 50k\Omega = r_o$

$$Z_i = R_B \| h_{ie} = \frac{(330k)(1.17k)}{(330k)+(1.17k)} = \boxed{1165.87\ \Omega}$$ ✓

$$Z_o = 1/h_{oe} \| R_c = \frac{(50k)(2.7k)}{(50k)+(2.7k)} = \boxed{2561.67\ \Omega} \approx R_c$$ 9

$1.17k = 120 r_e$

$r_e = \frac{1.17k}{120} = \boxed{9.75\ \Omega}$

$A_v = \frac{-R_c}{r_e}(\mu_f)$ ~~$A_v = \frac{\beta}{\beta}$~~

$$A_v = \frac{-Z_o}{r_e} = \frac{-2561.67}{9.75} = \boxed{-262.73\ V}$$

Question 2 (100 points)

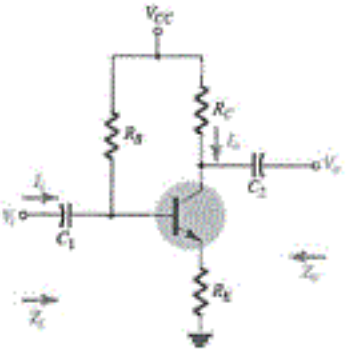
For Emitter bias configuration, derive the expression for

Z_i

Z_o

A_v

Solution



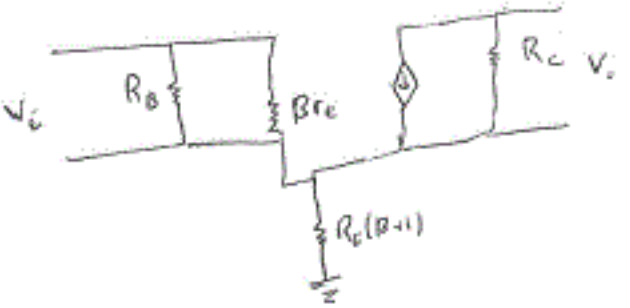
$Z_A = B r_e + R_E(\beta + 1)$

$= B(r_e + R_E)$

$\therefore Z_i = Z_A \parallel R_B$

$Z_o = R_C$

(4)

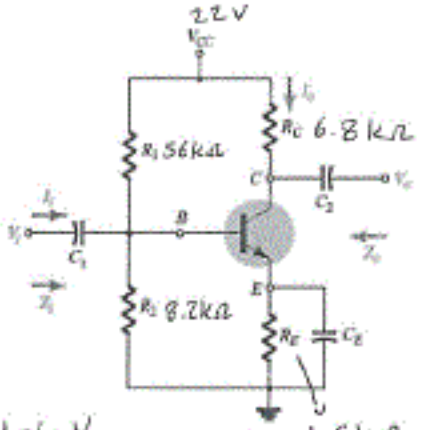


$$A_v = \frac{-V_o}{V_i} = \frac{-R_C}{R_E}$$

Question 1 (10 points)

For voltage divider bias configuration, find the following, Take r_o as 50kΩ. Draw the r_e small signal equivalent model and find

r_e
Z_i
Z_o
A_v



Solution

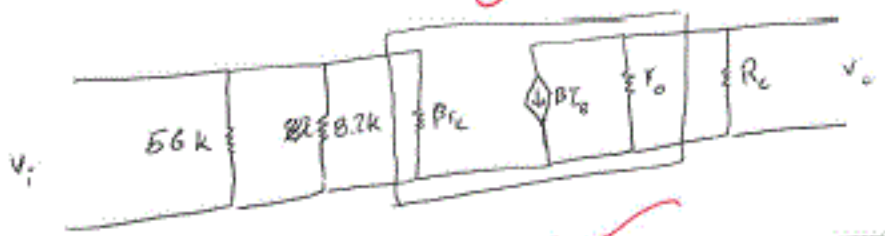
$$r_e = \frac{26m}{I_E}$$

~~$R_{Th} = 3460.87\Omega$~~ ~~V_{Th}~~

$$R_{Th} = \frac{56k \times 8.2k}{56k + 8.2k} = 7152.65\,\Omega \qquad V_{Th} = 2.81\,V = V_B$$

$$\therefore V_{BE} = V_B - V_E \Rightarrow 0.7 = 2.81 - V_E \quad (\therefore V_E = 2.11\,V)$$

$$\therefore I_E = \frac{2.11}{1.5k} = 1.407\,mA \qquad \therefore r_e = \frac{26\,m}{1.407m} = 18.479\,\Omega$$



$$Z_i = R_{Th} \| \beta r_e = \frac{7152.65 \times (90)(18.479)}{7152.65 + (90)(18.479)} = 1349.36\,\Omega$$

$$Z_o = R_c \| r_o = \frac{(6.8k)(50k)}{(6.8k) + (50k)} = 5985.91\,\Omega$$

$$A_v = \frac{-R_c \| r_o}{r_e} = \frac{-5985.91}{18.479} = -323.93\,V$$

Islamic University Faculty of Engineering Department of Electrical Engineering		الجامعة الإسلامية كلية الهندسة قسم الهندسة الكهربائية

EE 212 - ELECTRONICS II

Fall Semester 2016-2017

Midterm Exam 2

Exam Date: December 12, 2017; Exam Duration: 70 minutes

Student's Full Name: [redacted]

Student ID #: [redacted] **Section #: 1050 Signature:** [redacted]

Instructions:

- **Write your student ID number on the top of each page**
- **Write the solution in the space provided under each question**
- **Show all the details of your analysis and calculations**

Question No.	Points Assigned	Points Awarded
3. [CO_7, PI_5_53, SO_5]	10	10
4. [CO_7, PI_5_53, SO_5]	10	4
5. [CO_7, PI_5_53, SO_5]	10	9
Total	**30**	23

Instructor's Full Name	Dr. Abdul Waheed Malik
Signature	