1) Draw the small-signal equivalent circuit. (4 marks)

2) Find the mid-band gain $A_v$. (4 marks)

3) Find the mid-band $R_{in}$. (2 marks)

4) Find the mid band $R_{out}$ (include $r_{\mu 2}$, and $r_{o2}$). (3 marks)

5) Find the $\omega_L$'s for $C_{in}$, $C_1$, $C_2$, and $C_{out}$ (for $C_2$ only, assume $R_5$ is 0 $\Omega$). (4 marks)

6) Find the $\omega_H$'s for the circuit. Do not consider $C_{\pi 2}$. (4 marks)

7) Assume that $V_{cc} = 15V$, $\beta_1=50$, $\beta_2= 100$, If $R_{C1}, R_{E2}, R_3, R_4$, and $R_5$ are each 3 k$\Omega$, adjust $V_{BB}$ such that the input impedance of the circuit ($R_{in}$) is about 50$\Omega$. Determine the current in each of the transistors. If you can’t find the input impedance, then for part marks, adjust $V_{BB}$ so that the current through $Q_1$ is 1 mA and find the resulting current through $Q_2$. (4 marks)

$$r_\pi = \frac{\beta}{g_m}, \quad r_\pi = (\beta + 1)r_e, \quad \alpha = \frac{\beta}{\beta + 1}, \quad g_m = \frac{I_c}{V_T}, \quad V_T = 25mV \quad @ 20^\circ C.$$ 

$$\omega_L \approx \omega_{L1} + \omega_{L2} + \omega_{L3} + \ldots \quad \text{and} \quad \frac{1}{\omega_H} \approx \frac{1}{\omega_{H1}} + \frac{1}{\omega_{H2}} + \frac{1}{\omega_{H3}} + \ldots$$ 

Miller’s Theorem: $Y_1 = Y\left(1 - \frac{V_2}{V_1}\right)$, $Y_2 = Y\left(1 - \frac{V_1}{V_2}\right)$