ELEC 312: ELECTRONICS – II : ASSIGNMENT-4 (Hint/Sol)

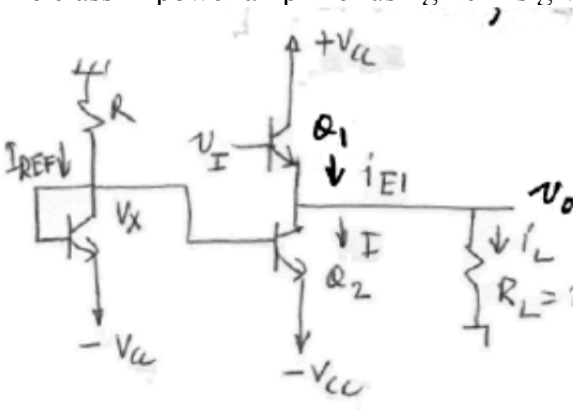
Department of Electrical and Computer Engineering

Fall – 2012

Q.1: Show the design of a class-A power amplifier using BJT devices, employed to deliver 10 W of ac signal power to a load of 10 ohms. Find the V_{CC} required, the I_Q required and design the active circuit to provide the required I_Q . Comment on the heat dissipation limits of the BJT devices used in your design. R

Hints:

The class-A power amplifier using BJT is given below:



$P_L = (1/2)\,(V_o^2/R_L)$, $V_o = \sqrt{(2\,P_L\,R_L)}$, $I_o = V_o/R_L$, for maximum efficiency $V_{CC} = V_o$, And $I_{CQ} = |I_o|$

Now follow the example (Problem 5.1) in ch.5 of my lecture note.

Q.2: Design an idealized class-B output stage as shown in Figure 2, to deliver an average of 25 W to an 8 Ω speaker. The peak output voltage must be no larger than 80% of supply voltages V_{CC}. Determine: (i) the required value of V_{CC}, (ii) the peak current in each transistor, (iii) the average power dissipated in each transistor, and (iv) the power conversion efficiency.

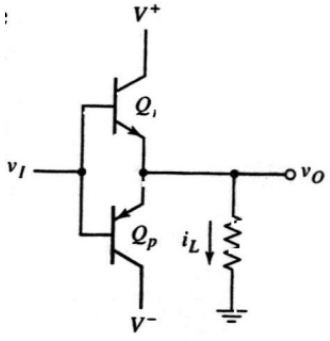


Figure 2: Basic class-B output stage

Hints:

(i) $P_L = (1/2)\,(V_o^2/R_L)$, $V_o = \sqrt{(2\,P_L\,R_L)}$ now, $V_o < 80\%$ of V_{CC}, hence $V_{CC} = V_o/0.8$

(ii) I_o (peak) = V_o (peak)/R_L

(iii) P_{Qn} (max) = P_{Qp} (max) = $V_{CC}^2/(\pi^2 R_L)$

(iv) $\eta = P_{load}/P_{supply}*100\%$, where $P_{load} = (1/2)\,(V_o^2/R_L)$ and $P_{S+} = P_{S-} = (1/\pi)(V_o/R_L)V_{CC}$, $P_{supply} = P_{S+} + P_{S-}$

Q.3: Determine the required biasing in a MOSFET class-AB output stage. The circuit is shown in Figure 3. The parameters are $V_{DD} = 10$ V and $R_L = 20\ \Omega$. The transistors are matched, and the parameters are $K = 0.20$ A/V^2 and $|V_T| = 1$ V. The quiescent drain current is to be 20% of the load current when $v_o = 5$ V.

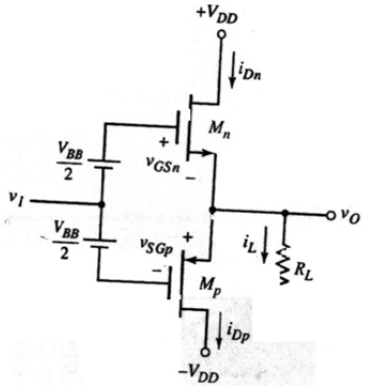


Figure 3: MOSFET class-AB output stage

Hints:

For $v_o = 5$ V, $i_L = v_o/R_L = 5/20 = 0.25$.

Then I_Q =20% 0f 0.25 A = 0.05 A .

$I_Q = i_{Dn} = i_{Dp}$, when $v_o = 0$. Thus $I_Q = K\,(V_{BB}/2 - |V_T|)^2$ calculate $V_{BB}/2$.