1. [32%] Consider the amplifier shown in Figure PR-1. DC analysis of the circuit with $V_{BE} = 0.7$ V and $\beta = 200$ yields $I_{CQ} = 2.088$ mA and $V_{CEQ} = 9.550$ V. The input voltage source is $v_{source} = 10 \sin(\omega_0 t)$ mV. Determine the following ($A_v = v_{out} / v_{in}$, $A_{v,overall} = v_{out} / v_{source}$, $A_i = i_{out} / i_{in}$, $R_{in} = v_{in} / i_{in}$): 

(a) $g_m = \quad$ (e) $A_i = \quad$

(b) $r_x = \quad$ (f) $R_{in} = \quad$

(c) $A_v = \quad$ (g) $R_{out} = \quad$

(d) $A_{v,overall} = \quad$ (h) $v_{out} = \quad$

Figure PR-1
2. [36%] Consider the two stage amplifier shown in Figure PR-2. The second (BJT) amplifier has the following characteristics: \(A_{v2} = \frac{v_{out}}{v_x} = -113\ V/V\), \(A_{i2} = \frac{i_{out}}{i_x} = -81.9\ A/A\), \(R_{in2} = \frac{v_x}{i_x} = 1.45\ k\Omega\), \(R_{out2} = 2\ k\Omega\). The n-channel JFET transistor used in the first amplifier has parameters \(I_{DSS} = 10\ mA\) and \(V_P = -6\ V\). DC analysis of the JFET amplifier yields: \(I_{DQ} = 3.52\ mA\), \(V_{DSQ} = 3.66\ V\), and \(V_{GSQ} = -2.44\ V\). Find each of the following \((A_{v1} = \frac{v_x}{v_{in}}, A_{i1} = \frac{i_x}{i_{in}}, A_v = \frac{v_{out}}{v_{in}}, A_i = \frac{i_{out}}{i_{in}})\):

(a) \(g_{m1} = \) ___________________  
(b) \(R_{in1} = \) ___________________  
(c) \(R_{out1} = \) ___________________  
(d) \(A_{v1} = \) ___________________  
(e) \(A_{i1} = \) ___________________  

![Figure PR-2](image-url)
3. [32%] Find values for \( R_D, R_{S1}, R_{S2}, R_1, \) and \( R_2 \) so that the amplifier shown in Figure PR-3 has \( A_v = -1.5 \text{ V/V} \) and \( A_i = -150 \text{ A/A} \) (\( A_v = \frac{v_{out}}{v_{in}} \) and \( A_i = \frac{i_{out}}{i_{in}} \)). The n-channel MOSFET (depletion) has parameters \( V_T = -6 \text{ V} \) and \( I_{DSS} = 10 \text{ mA} \). Select \( R_D \) for maximum power transfer to the load resistor. Design for a \( Q \) point of \( I_{DQ} = 4 \text{ mA} \) and \( V_{DSQ} = 8 \text{ V} \).

(a) \( V_{GSQ} = \) __________________ 
(b) \( g_m = \) __________________ 
(c) \( R_D = \) __________________ 
(d) \( R_{S1} = \) __________________ 
(e) \( R_{S2} = \) __________________ 
(f) \( R_I = \) __________________ 
(g) \( R_2 = \) __________________ 
(h) \( R_{in} = \) __________________ 

![Figure PR-3](image-url)