1. For the single stage shunt-shunt feedback amplifier shown below, determine the open loop transresistance gain (midband frequencies), the feedback factor, and the closed loop gain. The $\beta$ of the transistor is 100 for dc calculations, $V_{BE} = 0.65 \, \text{V}$, the dc power supply voltage $V^+ = 15 \, \text{V}$, $R_C = 5 \, \text{k}\Omega$, $R_B = 3 \, \text{k}\Omega$, $R_F = 12 \, \text{k}\Omega$, $R_1 = 1 \, \text{k}\Omega$, $R_E = 100 \, \text{\Omega}$, $R_L = 10 \, \text{k}\Omega$, $C_1 = 10 \, \mu\text{F}$, and $C_2 = 100 \, \mu\text{F}$. Use SPICE to determine the bias and transresistance and voltage gain of the amplifier. For the AC calculations assume $\beta = \infty$. Assume that the other SPICE parameters for the NPN BJT are: saturation current, 6.734 fA; Early voltage, 170 V, zero-bias base collector capacitance, 3.638 pF; forward transit time, 301.2 ps, and base spreading resistance, 10 $\Omega$. The transresistance gain, $A_r = v_o/i_i$. The voltage gain is $A_v = v_o/v_i$, where $v_i = R_1 i_i$. 

![Amplifier Circuit Diagram]