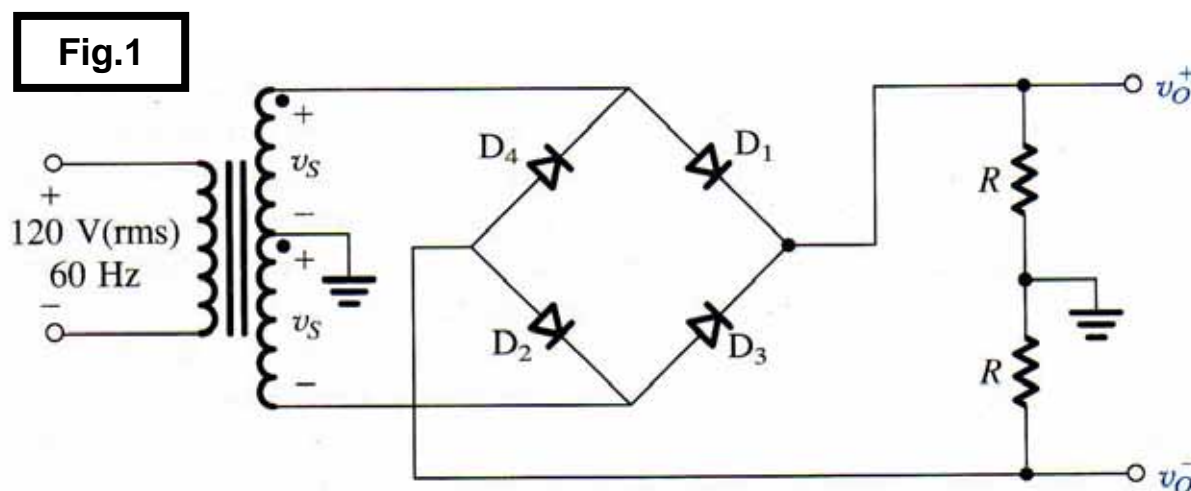1. The circuit in Fig.1 implements a complementary-output rectifier. Sketch and clearly label the waveforms of v_o^+ and v_o^-. Assume a 0.7-V drop across each conducting diode. If the magnitude of the average of each output is to be 15 V, find the required amplitude of the sine wave across the entire secondary winding. What is the peak inverse voltage of each diode? (15%)

2. In the emitter follower in Fig.2, the signal source is directly coupled to the transistor base. If the dc component of v_s is zero, find the dc emitter current. Assume β=120. Neglecting r_o, find R_i, the voltage gain v_o/v_s, the current gain i_o/i_i, and the output resistance R_o. (15%)

3. Figure 3 shows an IC MOS amplifier formed by cascading two common-source stages. Assuming the biasing current sources have very high output resistance, find an expression for the overall voltage gain in terms of g_m and r_o of Q_1 and Q_2. (15%)

4. Find v_E, v_{C1}, and v_{C2} in the circuit of Fig. 4. Assume that $|v_{BE}|$ of a conducting transistor is approximately 0.7 V and that α ≈1. (15%)

5. For the circuit of Fig. 5, use the feedback method to find the voltage gain V_o/V_s, the input resistance R_{in}, and the output resistance R_{out}. The op amp has open-loop gain μ=10^4 V/V, R_{id}=100 kΩ, and r_o = 1 kΩ. (20%)

6. An amplifier has the gain transfer function

$$A(s) = 100\frac{s}{s+2\pi\times100}\frac{1}{1+\dfrac{s}{2\pi\times10^5}}$$

Sketch a Bode plot for its magnitude and find the midband gain, the lower 3-dB frequency f_L, and the upper 3-dB frequency f_H. Also, find approximate values for the frequencies at which the gain decreases to unity. (20%)
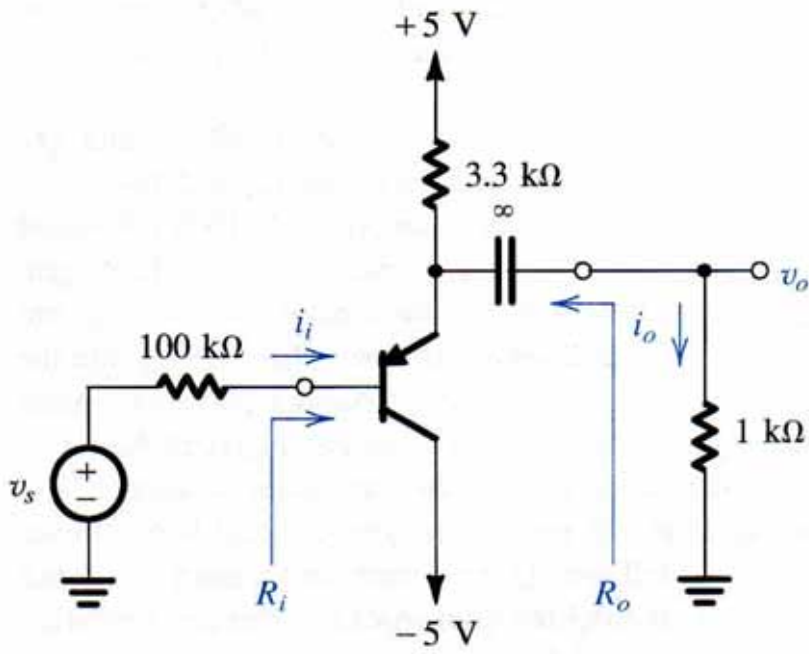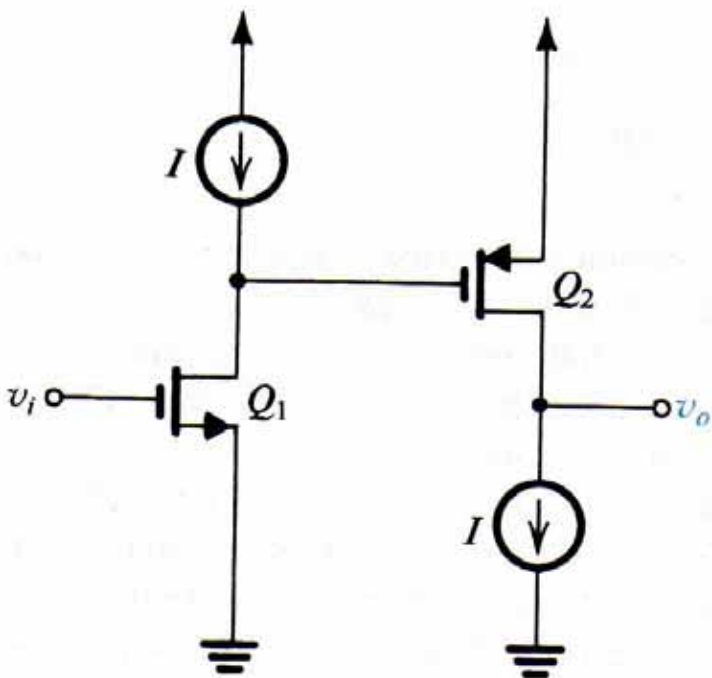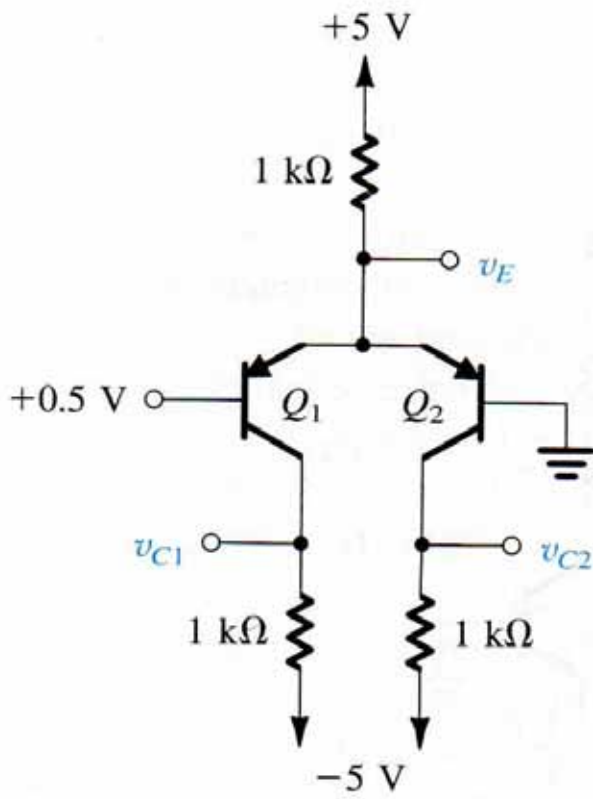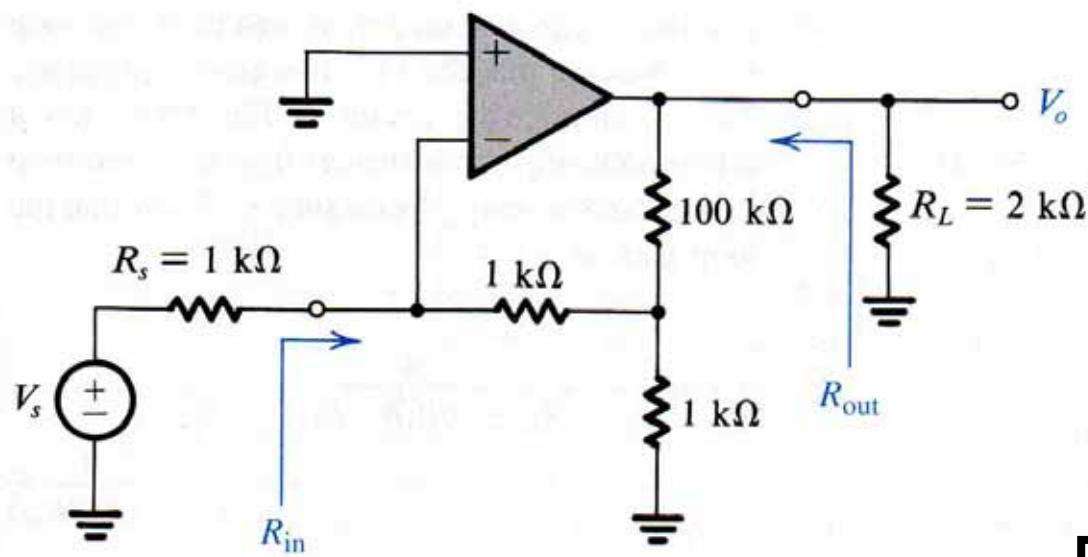

Fig.1

Fig.2

Fig.3

Fig.4

Fig. 5