1. Consider the circuit shown in Figure P1, in which the diode cut-in voltages are \( V_i = 0.6 \, \text{V} \). Plot \( V_o \) versus \( V_i \) for \( 0 \leq V_i \leq 10 \, \text{V} \). (15%)  

![Figure P1](image)

2. Consider the BJT circuit with coupling and load capacitors shown in Figure P2, the small-signal parameters include \( g_m \) and \( r_e \). (a) Derive the expression for the corner frequencies associated with \( C_\alpha \) (10%). (b) Plot the Bode plot of the voltage gain magnitude (10%).  

![Figure P2](image)

3. (a) For the circuit shown in Figure P3, assume \( I_{\text{bias}} = 0.2 \, \text{mA} \) and transistor parameters are \( V_{\text{BE}} = 0.8 \, \text{V}, \ V_{\text{BB}} = -0.8 \, \text{V}, \ K_n = 0.7 \, \text{mA/V}^2, \ K_p = 50 \, \text{mA/V}^2 \), and \( \lambda_n = \lambda_p = 0.01 \, \text{V}^{-1} \). Find the small-signal gain and output resistance of the circuit (10%). (b) Please explain what is body effect, and the influence of body effect (5%).  

![Figure P3](image)
4. Consider the current gain amplifier shown in Figure P4. Please derive the small-signal current gain of this amplifier. (15%)

![Figure P4](image1)

5. Consider the bandpass filter in Figure P5. Please derive the voltage transfer function of this filter circuit. (15%)

![Figure P5](image2)

6. Consider the oscillator circuit in Figure P6. (a) Derive the expression for the loop gain T(s). (10%) (b) Determine the expression for the frequency of oscillation. (5%) (c) Find the condition for oscillation. (5%)

![Figure P6](image3)