The circuit of Fig.1 is a Hartley oscillator with a sustaining circuit consisting of a field effect transistor with a source resistor $R_s$. Modeling the transistor with the parameters $r_D$ and $g_m$ and assuming lossless inductors, find the minimum $g_m$ required for oscillations.

A practical implementation of the Hartley in Fig.1 includes the clamping circuit of Fig.2. Using the values $L = 1\text{mh}$, $C_0 = 5\text{nf}$, $R_g = 50\text{K}$, $R_s = 510$, $C_c = 0.01\text{uf}$

Estimate the frequency of oscillations. Determine the frequency of oscillations by simulating the circuit. The FET is a 2N3819 and the diode is a 1N914. Begin the oscillations by putting an initial voltage on $C_0$ is $-9V$. 
The resonant frequency of the LC circuit in Fig.3 is $\omega_0$ and the circuit has a resonance resistance $R_0$. The inputs to the circuit are $v_g$ and $v_s$ where

where $v_g = V_G \cos(\omega_0 t)$, $v_s = V_S \cos(\omega_1 t)$

The FET is characterized by $i_d = I_{DSS} (1 + v_{GS}/V_t)^2$.

If $\omega_0 >> \omega_1$ and $Q$ is sufficiently large,

$$v_d(t) = V_0 [1 + M \cos(\omega_1 t)] \cos(\omega_0 t)$$

Estimate $V_0$ and $M$ in terms of $V_G$ and $V_S$

$$i_d = -g_m (v_g - v_s) \quad g_m = 2 I_{DSS} \left[1 + (v_g - v_s)/V_t\right]$$

A practical implementation for the circuit in Fig.3 appears in Fig.4. Simulate the implementation and record the drain voltage $v_D(t)$. The resistors in series with the inductors are included to yield a $Q$ of 10 for each.