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610 Fall 2010 – Problems to consider set 1

1. Redo the Hartley small signal circuit as covered in class by renumbering the two branches 2 & 3 with their new numbers being 3 &2, respectively, and then choose the new branch 2 (along with branch 1) in the tree. Give the new graph, its cut set and tie set matrices, the semistate equations and reduce the latter to state equations. Check the conditions for oscillation.

2. For the Hartley oscillator choose C=1uFd, R=1KOhm and L1=L2=L to give oscillations at f_0=20KHz. And find the necessary smallest gm.

3. For the values of components in problem 2, use the 4007 NMOS transistor run PSpice for the Hartley oscillator (you will need to set initial conditions labeled IC in Spice).. Spice schematic and library files for the 4007's can be found about 2/3 down at
http://www.ece.umd.edu/newcomb/courses/spring2010/303/ENEE303_spring2010.html
Here are the Spice models for the 4007 are:

```
*.model M4007N-X NMOS
.model M4007N nmos( Level=1 Tox=300n Uo=600 Kp=20.54u W=144u L=8u Vto=
1.3
+ Lambda=15m Cbd=4p Cbs=4p Cgdo=1.7n Cgso=1.7n Rs=1 Rd=1)
.model M4007P pmos(Level=1 Tox=300n Uo=300 Kp=10.32u W=328u L=8u Vto=-
1.5
+               Lambda=15m Cbd=8p Cbs=8p Cgdo=1.7n Cgso=1.7n Rs=1 Rd=1)
.model r_zap  res(r=1.73K)
.model d_zap  D(Is= 1p Rs=1 N=1 Xti=3 Eg=1.11 Cjo=.01p M=0 Bv=20
Ibv=.1u)
.model d_body D(Is=15n Rs=1 N=1 Xti=3 Eg=1.11 Cjo=10p M=.5 Vj=.75
+               Fc=.5 Isr=.15n Nr=2 Bv=20 Ibv=100u)
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4. Redo problem 1 when the coils are coupled with coefficient of coupling ½.

5. Redo problem 1 when the inductors have series loss resistance, rs, and the two transistor gate capacitors, Cgd & Cgs, are taken into account. This makes the system to be fourth order but one can still set the frequency of oscillation.