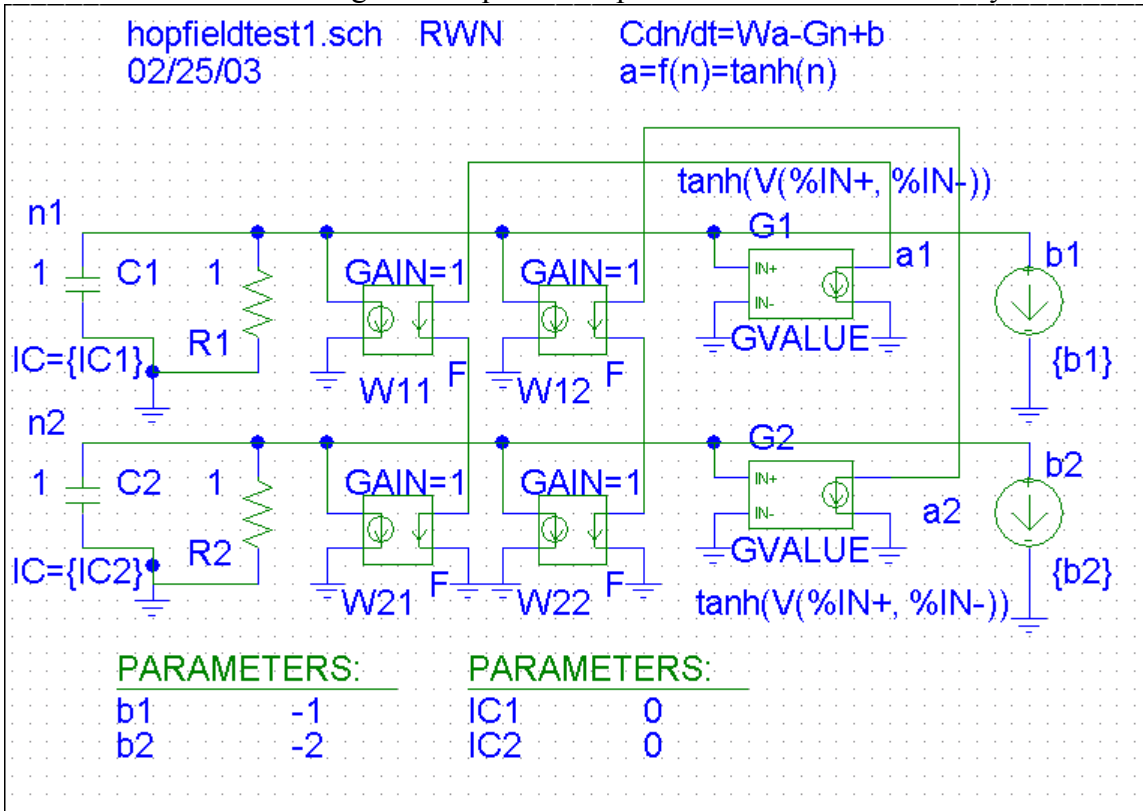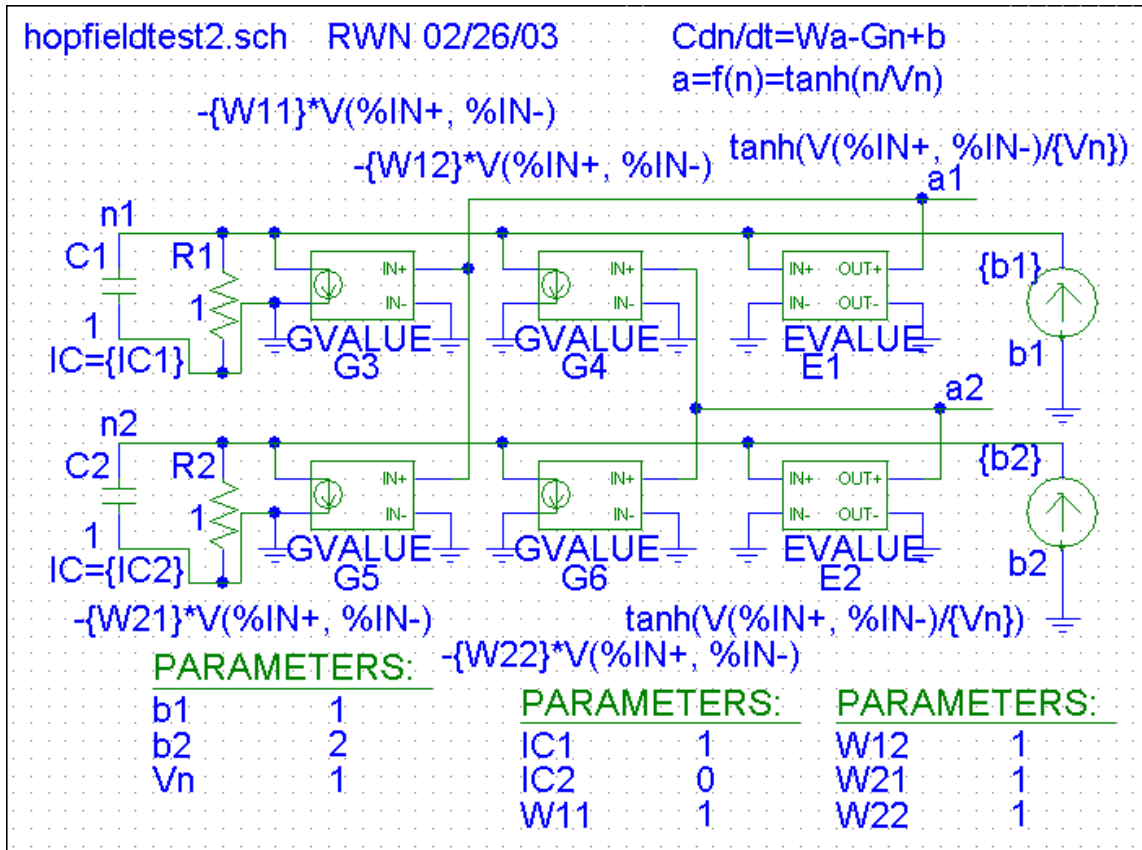ENEE 434 Spring 2003
To Do #5

1. Set up the following to run Spice and make different runs using different bias vectors b and also with different weight matrices. For each set of W and b choose several initial condition vectors to investigate the equilibrium points as well as their stability

2. Repeat 1. for the following schematic and compare results for the same W, b, and iniitial conditions.

hopfieldtest2.sch   RWN 02/26/03 $Cdn/dt = Wa - Gn + b$
                                        $a = f(n) = tanh(n/Vn)$

$-\{W11\}*V(\%IN+, \%IN-)$

$-\{W12\}*V(\%IN+, \%IN-)$ $tanh(V(\%IN+, \%IN-)/\{Vn\})$
                                a1

n1
C1   R1   IN+   IN+   IN+   OUT+   {b1}

1   1   GVALUE   GVALUE   EVALUE   b1
IC={IC1}   G3   G4   E1
                                                        a2
n2
C2   R2   IN+   IN+   IN+   OUT+   {b2}

1   1   GVALUE   GVALUE   EVALUE
IC={IC2}   G5   G6   E2   b2

$-\{W21\}*V(\%IN+, \%IN-)$ $tanh(V(\%IN+, \%IN-)/\{Vn\})$

$-\{W22\}*V(\%IN+, \%IN-)$

PARAMETERS:		PARAMETERS:		PARAMETERS:	
b1	1	IC1	1	W12	1
b2	2	IC2	0	W21	1
Vn	1	W11	1	W22	1

3. Give CMOS transistor realizations of each component in the above schematics (capacitors, resistors, voltage controlled current sources, current controlled current sources, voltage controlled voltage sources and current sources). Use 1.6 micron MOSIS transistors. From those give two types of transistorized versions of the 2-neuron Hopfield neural network. You can not run the full circuit in the Evaluation version of PSpice but you can make netlists of subparts and then put them together in the UNIX Berkeley Spice. Since the capacitors will not be 1 Farad, etc., you will need to do some scaling so rewrite the Hopfield neural network equations to go with the component values used with the CMOS circuits.

4. Investigate the 2-neuron Hopfield neural network when the current sources are not constants. Note that the describing differential equations remain the same, but the same can not be said about the Lyapunov function.