Synapses

Simulate two neurons which have synaptic connections between each other, that is the first neuron projects to the second, and the second neuron projects to the first. Both model neurons should have the same parameters: $\tau_m = 20$ ms, $E_L = -70$ mV, $V_r = -80$ mV, $V_t = -54$ mV, $R_m I_e = 18$ mV and their synapses should also have the same parameters: $R_m \bar{g}_s = 0.075$, $\tau_s = 10$ ms. For simplicity take the synaptic conductance to satisfy

$$\tau_s \frac{s}{dt} = -s \tag{1}$$

with a spike arriving causing s to increase by one, take the synapse strength to be $g_s = \bar{g}_s s$. Simulate two cases: a) assuming that the synapses are excitatory with $E_s = 0$ mV, and b) assuming that the synapses are inhibitory with $E_s = -80$ mV. For each simulation set the initial membrane potentials of the neurons V to different values chosen randomly from between V_r and V_t and simulate 1 s of activity. For each case plot the voltages of the two neurons on the same graph with different colours.

You'll notice that there is no seperate figure given for R_m, just $R_m \bar{g}_s$ and $R_m I_e$, but, since the voltages for each neuron satisfies an equation of the form

$$\tau_m \frac{dV}{dt} = E_L - V + R_m \bar{g}_s s (E_s - V) + R_m I_e \tag{2}$$

this is all that is needed.