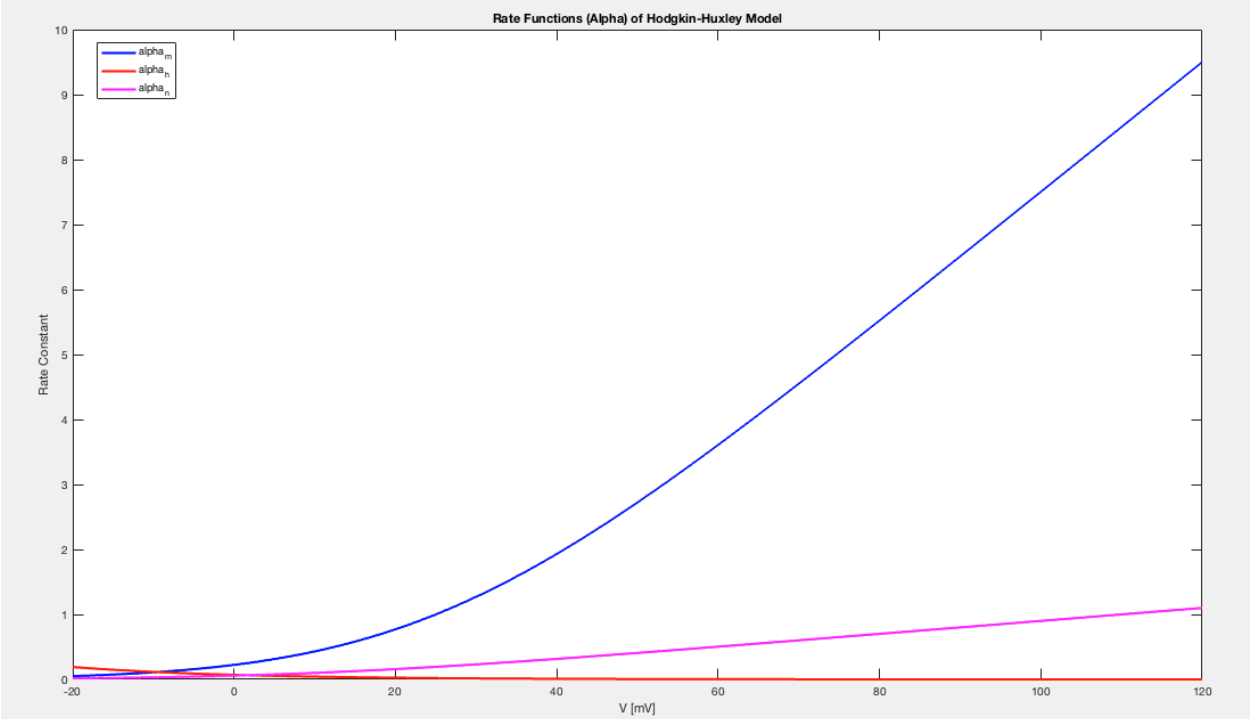
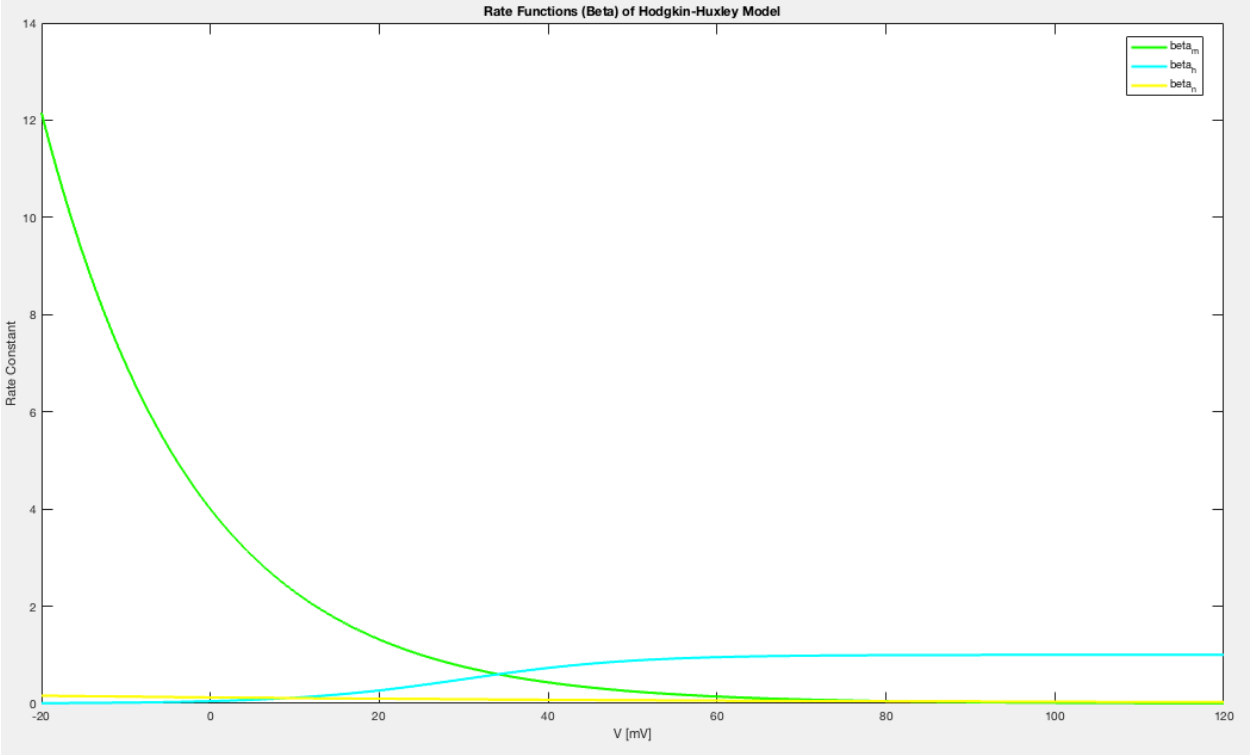
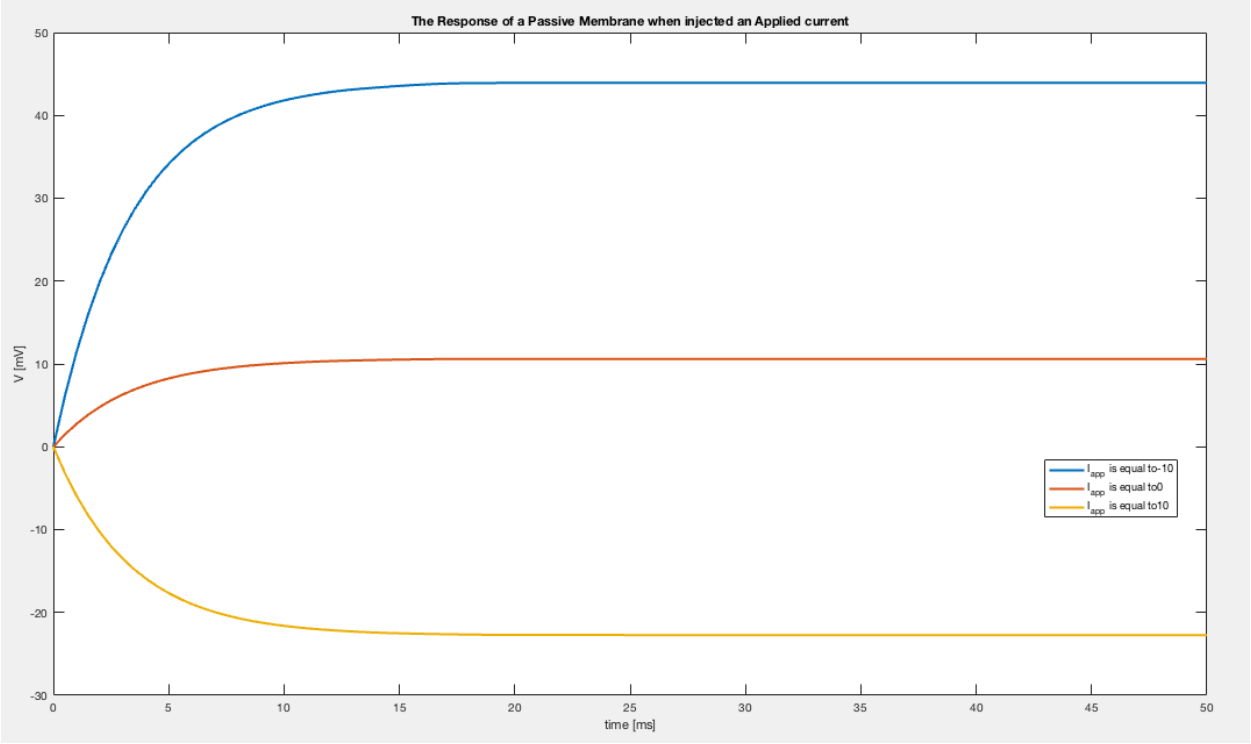
Problem 3

a.


Rate Functions (Alpha) of Hodgkin-Huxley Model
alpha_m
alpha_h
alpha_n
Rate Constant
V [mV]

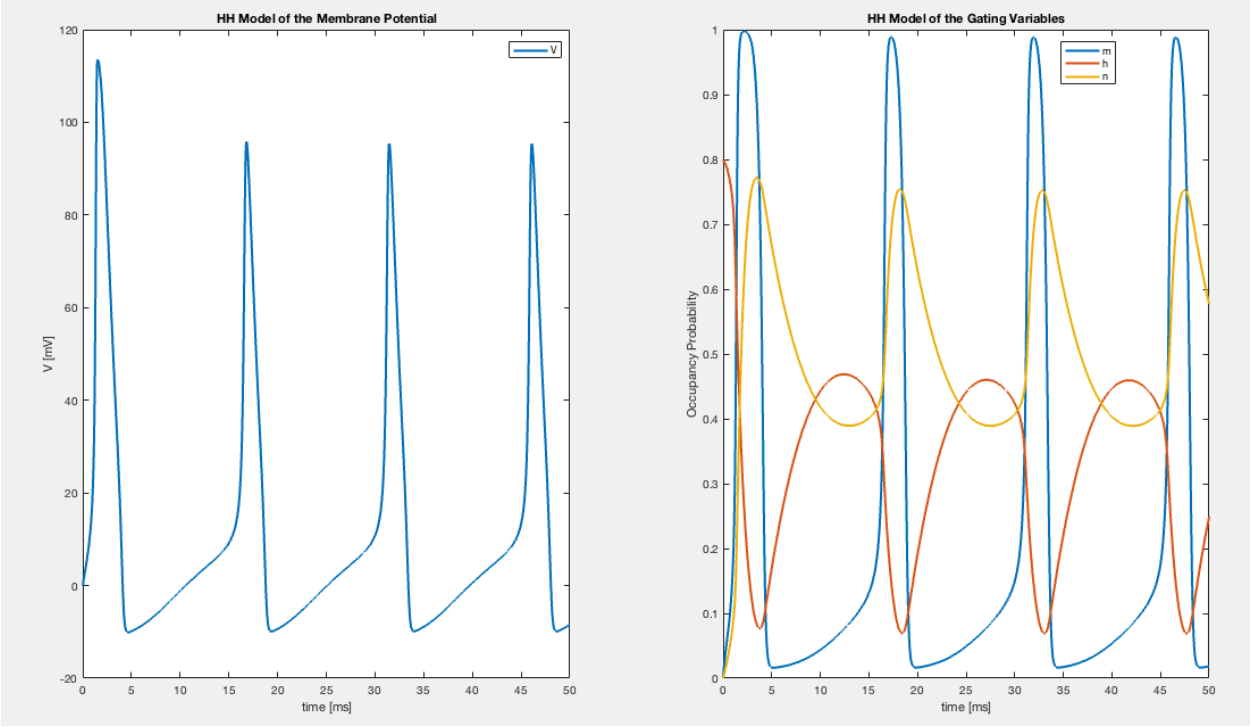

Rate Functions (Beta) of Hodgkin-Huxley Model
beta_m
beta_h
beta_n
Rate Constant
V [mV]

b.

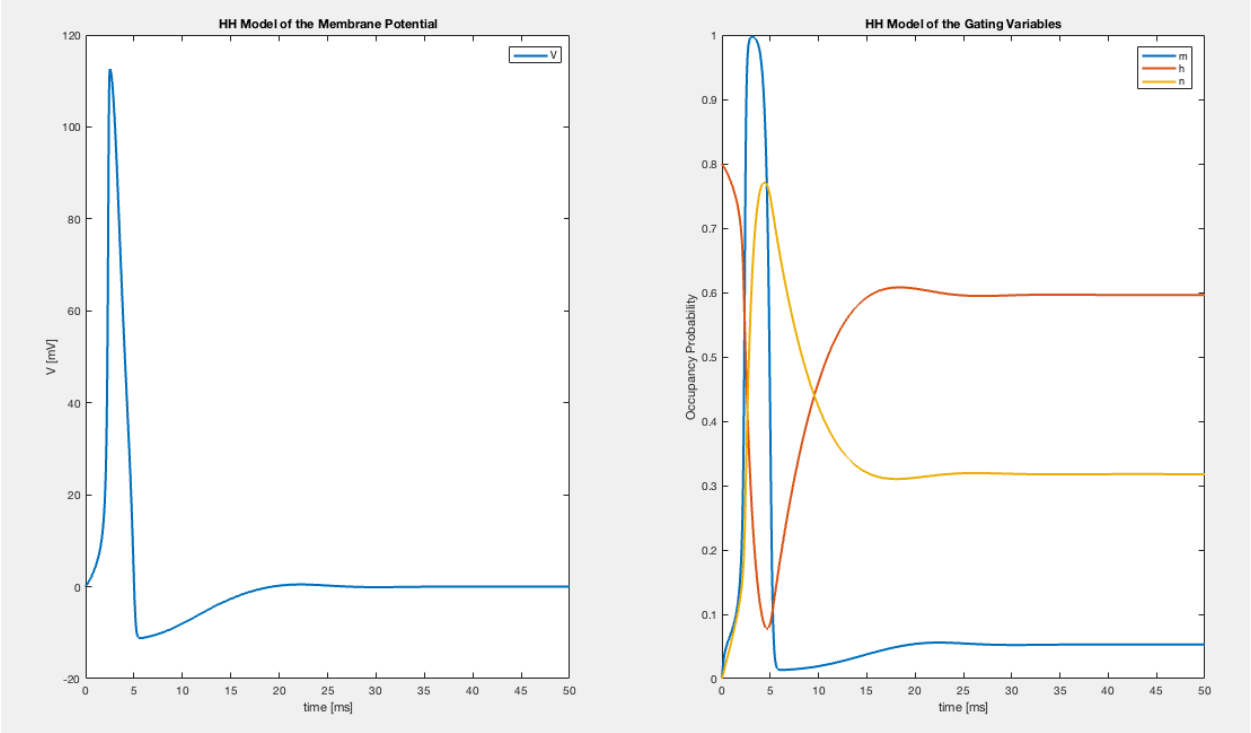


c.

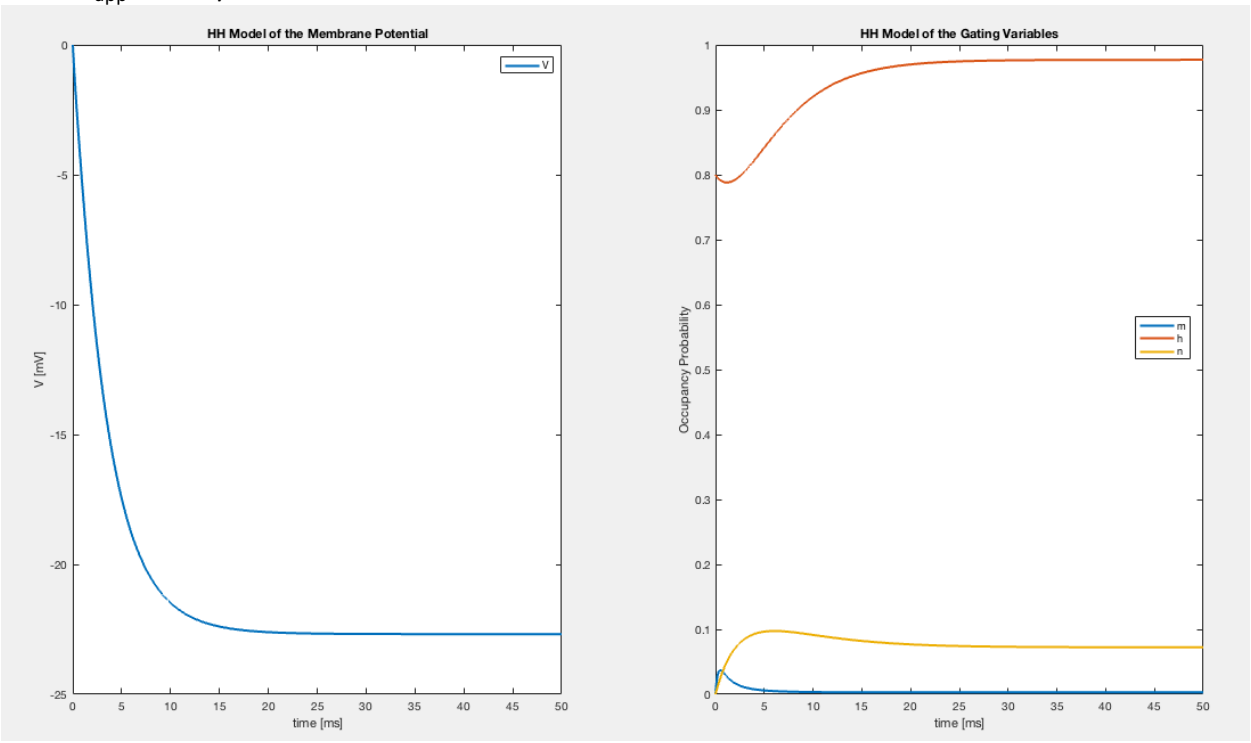
When I_{app}=-10 uA/cm^2



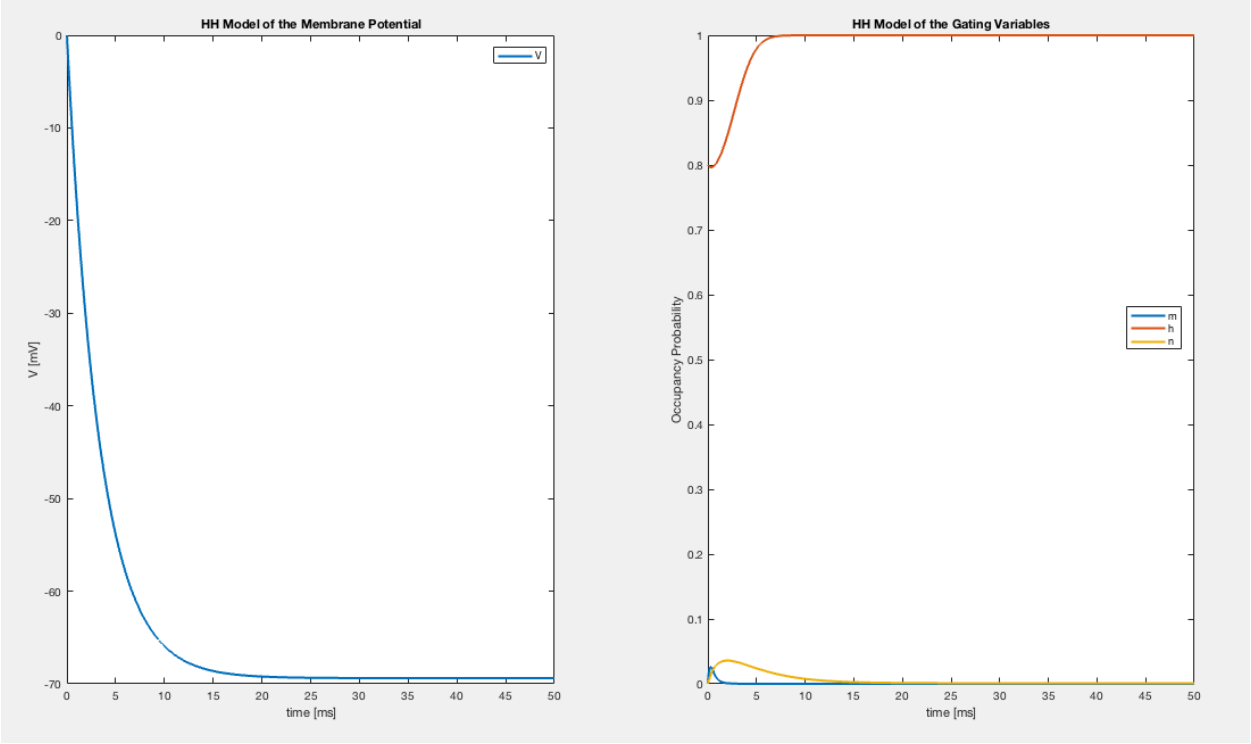
When I_{app}=0 uA/cm^2



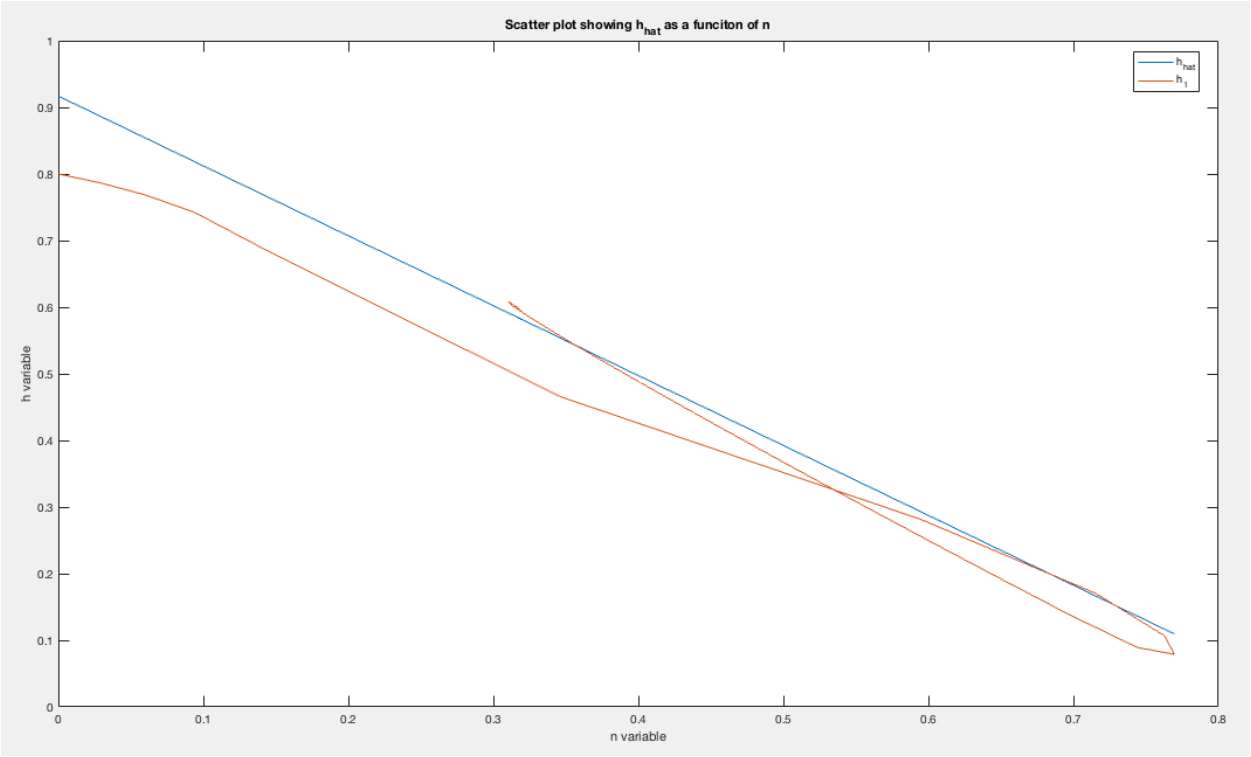
When I_{app}=10 uA/cm^2

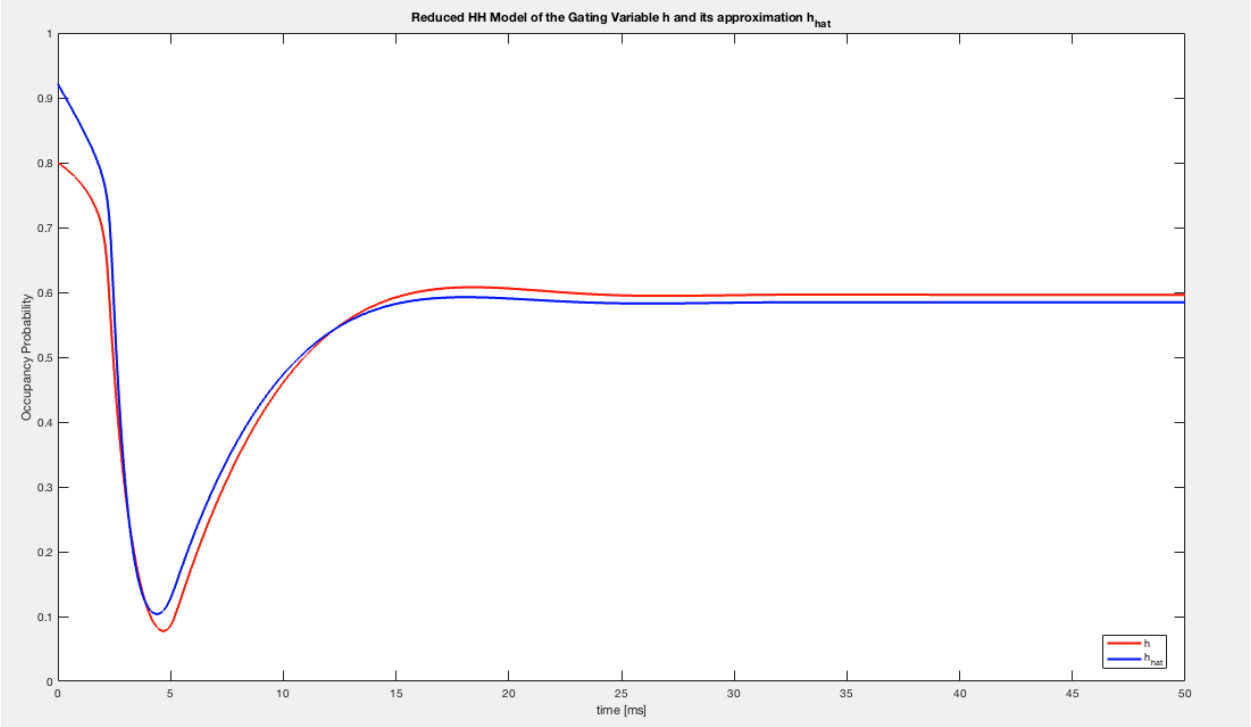


d). When I_{app}=24 uA/cm^2, the resting potential is set to -70mV.


HH Model of the Membrane Potential
V
V [mV]
time [ms]
HH Model of the Gating Variables
m
h
n
Occupancy Probability
time [ms]

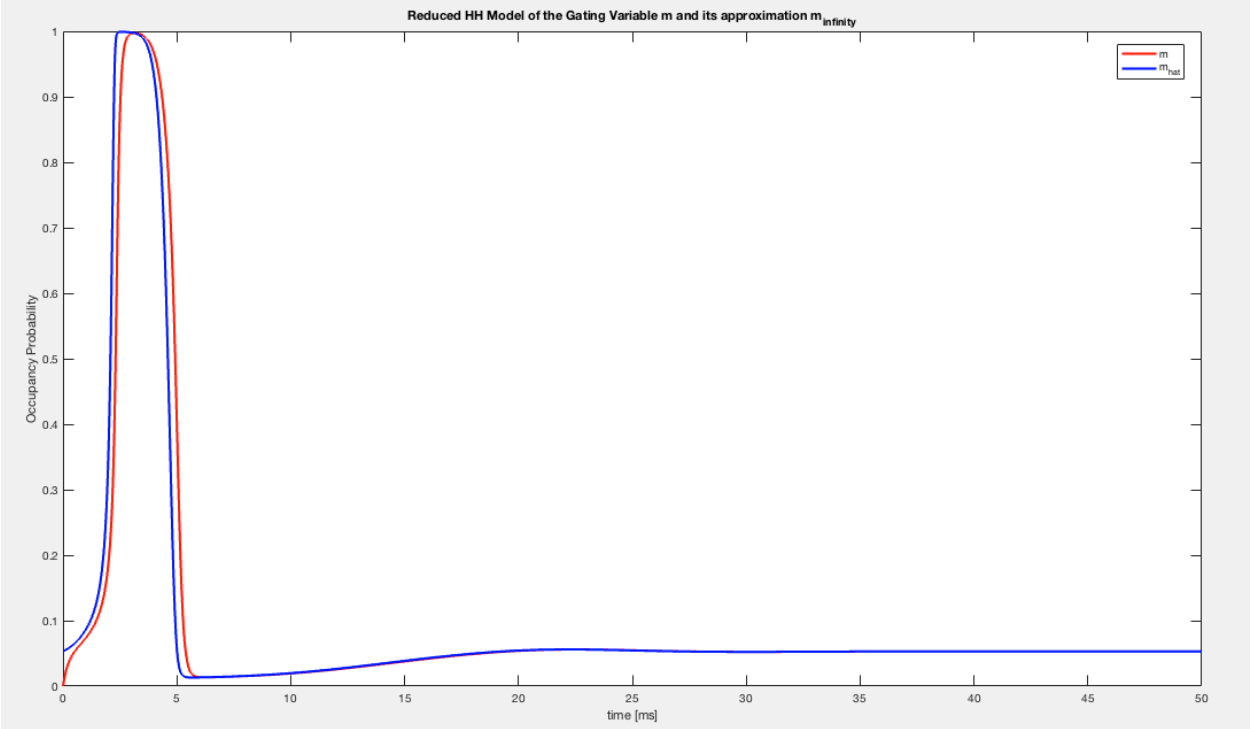
(e).


Scatter plot showing h_hat as a funciton of n
h_hat
h_1
h variable
n variable



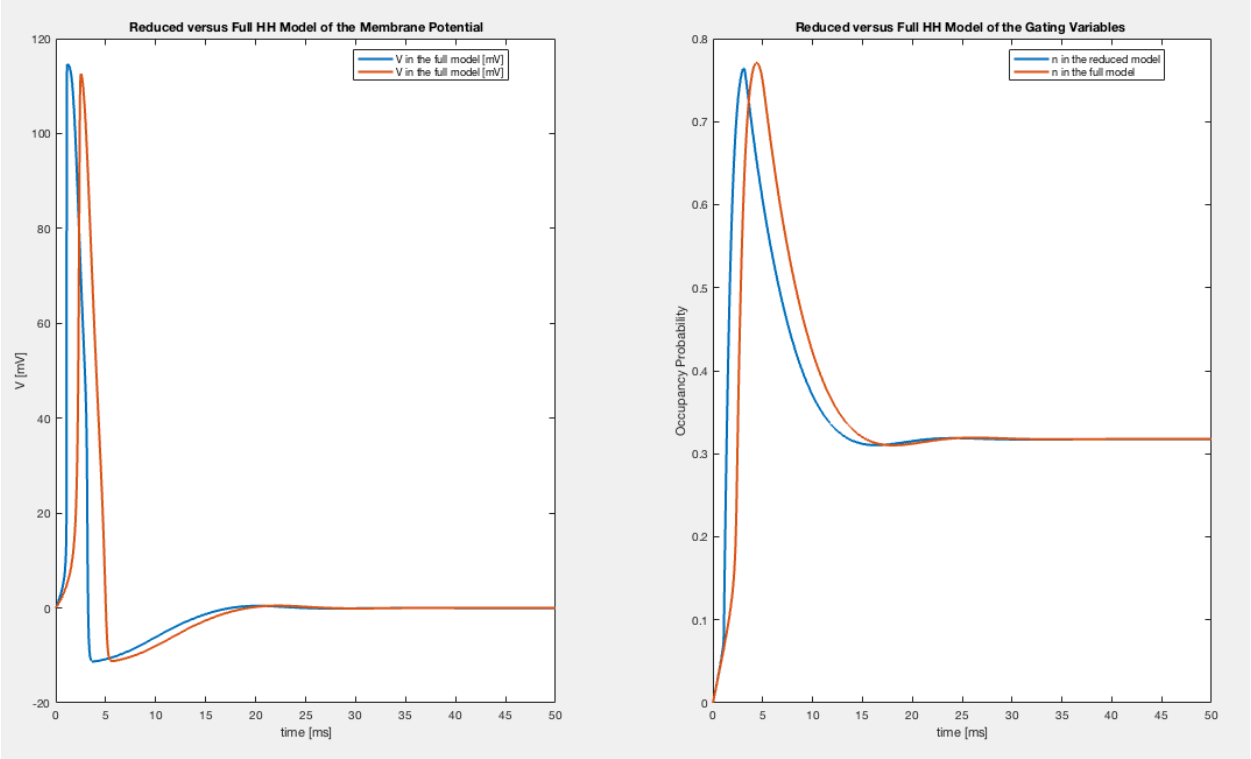
a= -1.061 ; b= 0.922

(f).



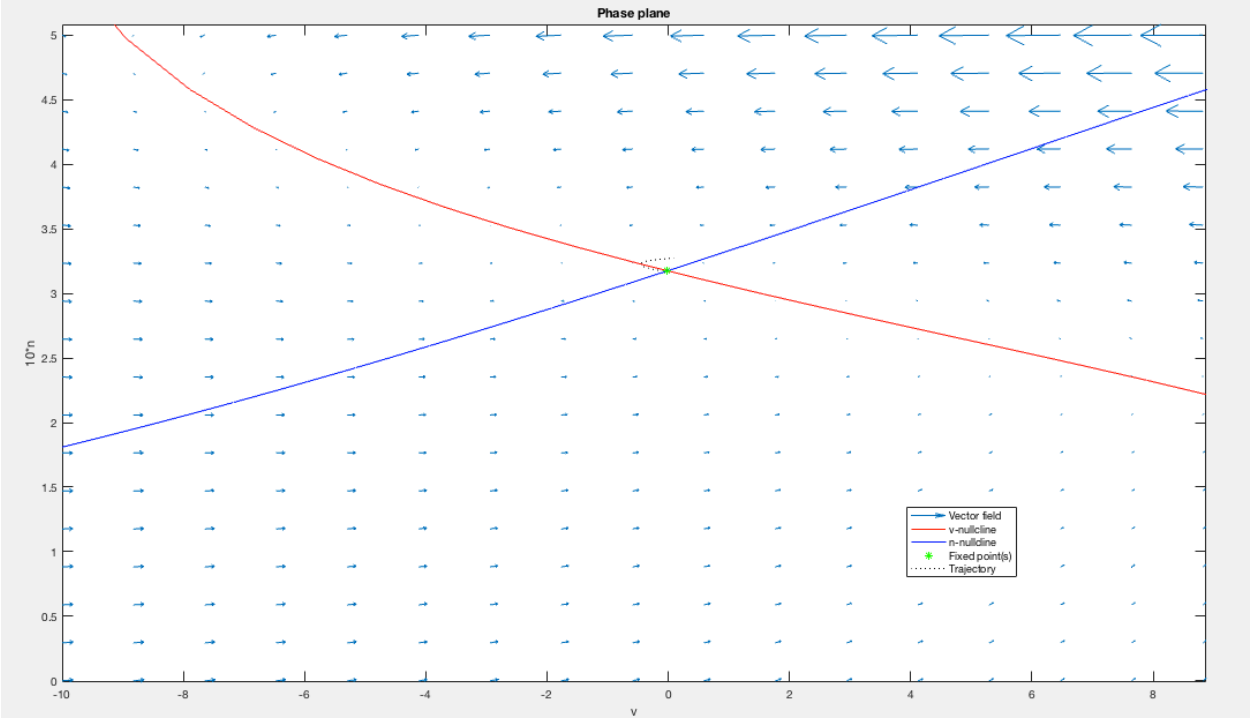
m_∞ is a good approximation to m

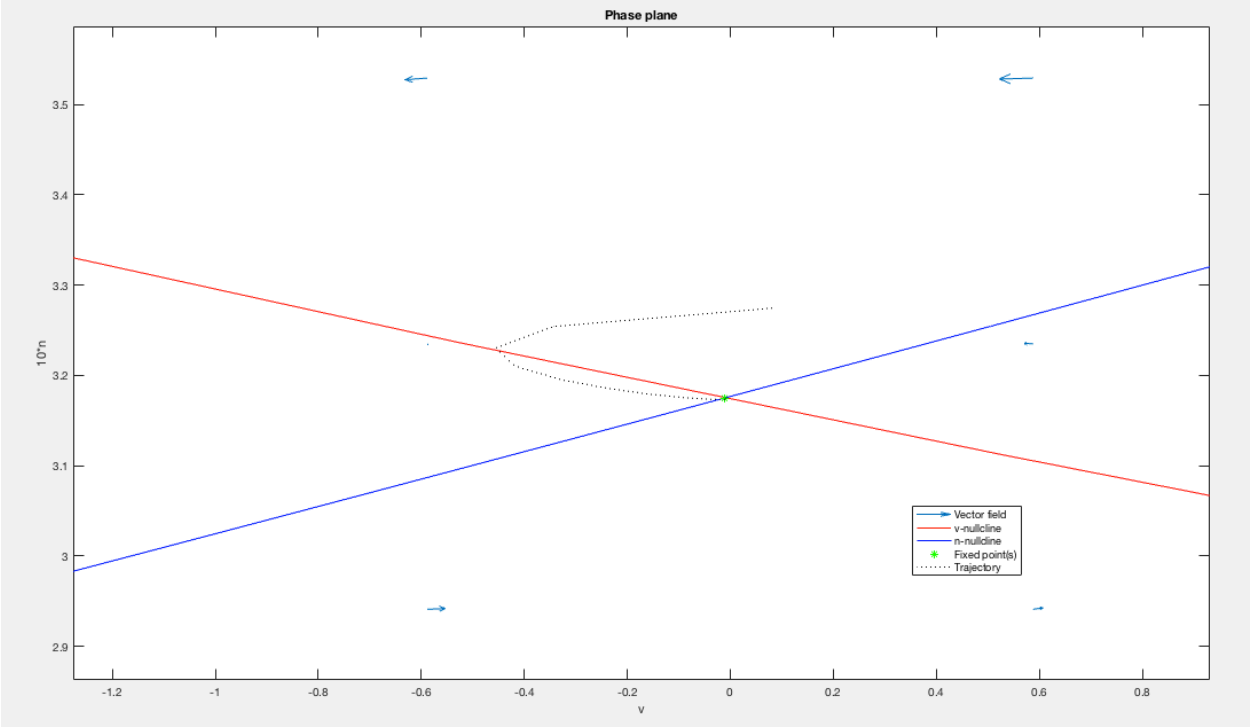
(g).



Overall, the reduced HH is a good replacement for the full model and the two models overlap to each other after 30 ms.

(h).




Phase plane
10*n
v
3.5
3.4
3.3
3.2
3.1
3
2.9
-1.2
-1
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
Vector field
v-nullcline
n-nullcline
Fixed point(s)
Trajectory