function HPA\_simulationhour()

% Define parameters

h1 = 0.1732;

h2 = 0.0315;

h3 = 0.0105;

k1 = 0.4342;

k3 = 0.2166;

k4 = 0.0821;

k5 = 0.00420;

del = 3;

alpha = 4;

beta = 3;

gamma = 3;

phi = 0.160;

rho = 0.5;

sai = 0.5;

gi = 4;

Ra = 0.78;

RD = 1.3;

Rc = 1.12

tspan = [0, 1450]; % Simulation time span in minutes

R0 = 0.2;

A0 = 5;

C0 = 2;

% Solve the system of equations using ODE45

[t\_minutes, y] = ode45(@differential\_equations, tspan, [R0, A0, C0]);

% Convert time from minutes to hours for visualization

t\_hours = t\_minutes / 60;

% Extract the solutions

R = y(:, 1);

A = y(:, 2);

C = y(:, 3);

% Plot the results

figure;

plot(t\_hours, R, 'r', 'LineWidth', 2);

hold on;

plot(t\_hours, A, 'g', 'LineWidth', 2);

hold on;

plot(t\_hours, C, 'b', 'LineWidth', 2);

xlabel('Time (hours)');

ylabel('Hormone concentration');

legend('CRH','ACTH','Cortisol');

title('Hormone Simulation');

xlim([0, 24]);

xticks(0:1:24);

% Define the system of differential equations

function dydt = differential\_equations(t, y)

R = y(1);

A = y(2);

C = y(3);

% Calculate time-dependent signal s\_t

if t >= 3\*60 && t <= 4\*60 % Input the interval of acute stressors

Am = 1;

phi = pi/4;

f0 = 5;

m\_t =10; % no of neurons fire in response modulation of acute stressor n=10

fi\_t = f0 + m\_t;

s\_t = Am \* cos(2\*pi\*fi\_t.\*t + phi);

else

s\_t = 0; % Assign zero for time outside 7 to 9 hours

End

D = 1/11.1 \* (((3.9\*sin(pi\*t/720)) - sin(2\*pi\*t/720) - (1.3\*cos(2\*pi\*t/720)) - 2.8\*(cos(pi\*t/720)))) + 0.4;

% Calculate the Hill functions

H1 = (1 + gi \* C^beta / (C^beta + Rc^beta) - sai \* C^del / (C^del + Rc^del));

H2 = (1 - phi \* A^alpha / (A^alpha + Ra^alpha));

H3 = (1 - rho \* C^beta / (C^beta + Rc^beta));

% Calculate the derivatives

dRdt = (s\_t + k1 \* D) \* H1 \* H2 - h1 \* R;

dAdt = (k2 \* (D^gamma / RD^gamma + D^gamma) + k3 \* R) \* H3 - h2 \* A;

dCdt = k4 \* A - h3 \* C;

dydt = [dRdt; dAdt; dCdt];

end

end