Lab 10-11

Problem 6

```
clear all; close all; clc;

tnow=datestr(now,30);

%Input parameters-----------------------------------
dt=0.0001;
t_sim=1;
dx=0.0001;
X=0.002;
Ta=20;
h=0;
k=16;
c=480;
rho=7810;
q_max=2000000;
t_max=0.001;
T0=20;
%---------------------------------------------------

x=0:dx:X;
t=0:dt:t_sim; t=t';

s1=size(x,2);
s2=size(t,1);

T=zeros(s2,s1+2);
q=q_max*t/t_max.*exp(1-t/t_max);
a=k/rho/c;
sig=a*dt/dx^2;

T(1,:)=T0;

for n=1:s2-1,
   i=2;
   T(n,i-1)=2*dx/k*(q(n,1)-h*(T(n,i)-Ta))+T(n,i+1);
   i=s1+1;
   T(n,i+1)=-2*dx*h/k*(T(n,i)-Ta)+T(n,i-1);
   for i=2:s1+1,
      T(n+1,i)=sig*(T(n,i-1)-2*T(n,i)+T(n,i+1))+T(n,i);
   end
end

T_half=(max(T(:,end-1))-T0)/2;
t_half=interp1(T(:,end-1)-T0+t*1e-10,t,T_half);
a_calc=1.38*X^2/t_half/pi^2;
a_err=(a_calc-a)/a*100;
```

```
% Plotting-----------------------------------------
[XX,YY]=meshgrid(x,t);

h1=figure(1);
contour(XX,YY,T(:,2:s1+1),20);
xlabel('x, m');
ylabel('t, s');
zlabel('T, °C');
colorbar;
grid on;

h3=figure();
plot(t,T(:,end-1),t_half,T_half+T0,'rd');
legend(['x=' num2str(x(end,1)) ' m']);
xlabel('t, s');
ylabel('T, °C');
grid on;

h4=figure(4);
surf(XX,YY,T(:,2:s1+1));
xlabel('x, m');
ylabel('t, s');
zlabel('T, °C');
grid on;
shading flat;
%-----------------------------------------------------

%Saving-------------------------------------------------
saveas(h1,[ tnow '_temp_contour']);
saveas(h3,[ tnow '_T_t']);
saveas(h4,[ tnow '_temp_surf']);

p6.IN.X=X;
p6.IN.dx=dx;
p6.IN.t_sim=t_sim;
p6.IN.dt=dt;
p6.IN.h=h;
p6.IN.q_max=q_max;
p6.IN.t_max=t_max;
p6.IN.k=k;
p6.IN.rho=rho;
p6.IN.c=c;
p6.IN.Ta=Ta;
p6.IN.T0=T0;


p6.OUT.T=T;
p6.OUT.x=x;
p6.OUT.t=t;
p6.OUT.a_calc=a_calc;
p6.OUT.a=a;
p6.OUT.a_err=a_err;

save([tnow '_p6'], 'p6');
%-----------------------------------------------------
```