

Lab 8-9

Problem 4

```
clear all; close all; clc;

tnow=datestr(now,30);

%Input parameters-----
N=100000;
E_limit=1e-6;
dx=0.00005;
X=0.002;
Y=0.001;
Ta=20;
hmin=2000;
hmax=8000;
HTC1=2000;
k=16;
qV=2e8;
%-----

x=0:dx:X;
y=0:dx:Y; y=flipr(y); y=y';
s1=size(x,2);
s2=size(y,1);

T=zeros(s2+2,s1+2); T=T+50;
E=zeros(N,1);

HTC2=zeros(1,s1+2);
HTC2(1,2:end-1)=linspace(hmax,hmin,s1);

TT=T;
it=1;
E_act=1;

while E_act>E_limit,

    if it>N,
        STOP='maximum number of iterations reached'
        break
    end

    for j=2:s1+1,
        i=2;
        TT(i-1,j)=2*HTC2(1,j)*dx/k*(Ta-T(i,j))+T(i+1,j);
        i=s2+1;
        TT(i+1,j)=T(i-1,j);
    end

end
```

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    for i=2:s2+1,
        j=2;
        TT(i,j-1)=T(i,j+1);
        j=s1+1;
        TT(i,j+1)=2*dx*HTC1/k*(Ta-T(i,j))+T(i,j-1);
    end

    for j=2:s1+1,
        for i=2:s2+1,
            TT(i,j)=(T(i+1,j)+T(i-1,j)+T(i,j+1)+T(i,j-1))/4+qV*dx^2/4/k;
        end
    end

    E(it)=max(max(abs(T-TT)));
    E_act=E(it);
    T=TT;
    it=it+1;

end

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

h1=figure(1);
contour(XX,YY,T(2:s2+1,2:s1+1),20);
xlabel('x, mm');
ylabel('y, mm');
zlabel('T, °C');
colorbar;
grid on;

h2=figure(2);
semilogy(E);
xlabel('Number of iterations');
ylabel('Maximum error, °C');
grid on;

h3=figure(3);
plot(x,T(round(s2/2)+1,2:s1+1));
legend(['y=' num2str(y(round(s2/2),1)) ' mm']);
xlabel('x, mm');
ylabel('T, °C');
grid on;

h4=figure(4);
surf(XX,YY,T(2:s2+1,2:s1+1));
xlabel('x, mm');
ylabel('y, mm');
zlabel('T, °C');
grid on;
%-----

%Saving-----
saveas(h1,['_temp_contour']);
saveas(h2,['_error']);
saveas(h3,['_T_x']);
saveas(h4,['_temp_surf']);

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```
p4.IN.X=X;  
p4.IN.Y=Y;  
p4.IN.dx=dx;  
p4.IN.HTC1=HTC1;  
p4.IN.HTC2=HTC2;  
p4.IN.k=k;  
p4.IN.Ta=Ta;  
p4.IN.qV=qV;  
p4.IN.N=N;  
p4.IN.E_limit=E_limit;
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```
p4.OUT.T=T;  
p4.OUT.x=x;  
p4.OUT.y=y;  
p4.OUT.E=E;  
p4.OUT.it=it;
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```
save([tnow '_p4'], 'p4');
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%-----
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Problem 5

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clear all; close all; clc;

tnow=datestr(now,30);

%Input parameters-----
N=100000;
E_limit=1e-6;
dx=0.00005;
X=0.002;
Y=0.001;
Ta=20;
hmin=2000;
hmax=8000;
HTC1=2000;
k1=16;
k2=32;
qV1=2e8;
qV2=0;
%-----

x=0:dx:X;
y=0:dx:Y; y=flipr(y); y=y';
s1=size(x,2);
s2=size(y,1);

border=round(s1/2);

T=zeros(s2+2,s1+2); T=T+50;
E=zeros(N,1);

HTC2=zeros(1,s1+2);
HTC2(1,2:end-1)=linspace(hmax,hmin,s1);

TT=T;
it=1;
E_act=1;
km=(k1+k2)/2;

while E_act>E_limit,

    if it>N,
        STOP='maximum number of iterations reached'
        break
    end

    for j=2:border,
        i=2;
        TT(i-1,j)=2*HTC2(1,j)*dx/k1*(Ta-T(i,j))+T(i+1,j);
    end

    j=border+1;
    i=2;
    TT(i-1,j)=2*HTC2(1,j)*dx/km*(Ta-T(i,j))+T(i+1,j);
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for j=border+2:s1+1,
    i=2;
    TT(i-1,j)=2*HTC2(1,j)*dx/k2*(Ta-T(i,j))+T(i+1,j);
end

for j=2:s1+1,
    i=s2+1;
    TT(i+1,j)=T(i-1,j);
end

for i=2:s2+1,
    j=2;
    TT(i,j-1)=T(i,j+1);
    j=s1+1;
    TT(i,j+1)=2*dx*HTC1/k2*(Ta-T(i,j))+T(i,j-1);
end

for i=2:s2+1,
    for j=2:border,
        TT(i,j)=(T(i+1,j)+T(i-1,j)+T(i,j+1)+T(i,j-1))/4+qV1*dx^2/4/k1;
    end
    j=border+1;
    TT(i,j)=1/(2*(k1+k2))*(k1*T(i,j-1)+k2*T(i,j+1)+km*(T(i+1,j)+T(i-1,j)))+(qV1+qV2)/2*dx^2);

    for j=border+2:s1+1,
        TT(i,j)=(T(i+1,j)+T(i-1,j)+T(i,j+1)+T(i,j-1))/4+qV2*dx^2/4/k2;
    end

end

E(it)=max(max(abs(T-TT)));
E_act=E(it);
T=TT;
it=it+1;

end

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

h1=figure(1);
contour(XX,YY,T(2:s2+1,2:s1+1),20);
xlabel('x, mm');
ylabel('y, mm');
zlabel('T, °C');
colorbar;
grid on;

h2=figure(2);
semilogy(E);
xlabel('Number of iterations');
ylabel('Maximum error, °C');
grid on;

```

```

h3=figure(3);
plot(x,T(round(s2/2)+1,2:s1+1));
legend(['y=' num2str(y(round(s2/2),1)) ' mm']);
xlabel('x, mm');
ylabel('T, °C');
grid on;

h4=figure(4);
surf(XX,YY,T(2:s2+1,2:s1+1));
xlabel('x, mm');
ylabel('y, mm');
zlabel('T, °C');
grid on;
%-----

%Saving-----
saveas(h1,[ tnow '_temp_contour']);
saveas(h2,[ tnow '_error']);
saveas(h3,[ tnow '_T_x']);
saveas(h4,[ tnow '_temp_surf']);

p5.IN.X=X;
p5.IN.Y=Y;
p5.IN.dx=dx;
p5.IN.HTC1=HTC1;
p5.IN.HTC2=HTC2;
p5.IN.k1=k1;
p5.IN.k2=k2;
p5.IN.Ta=Ta;
p5.IN.qV1=qV1;
p5.IN.qV2=qV2;
p5.IN.border=border;
p5.IN.N=N;
p5.IN.E_limit=E_limit;

p5.OUT.T=T;
p5.OUT.x=x;
p5.OUT.y=y;
p5.OUT.E=E;
p5.OUT.it=it;

save([tnow '_p5'], 'p5');
%-----

```