

CS 419 Homework 3

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3.1

```
n = 10;
h = 100;
k = .1;
m1=ones(n-2,1);
A = spdiags([m1 -2*m1 m1], [-1 0 1], n-2, n-2);
b=zeros(n-2,1);
b(1,1) = 0;
b(n-2,1)=10;
tau = 1/abs(eig(A));
for i=1:n-2
    xj = (h/2) + ((i-1) *h);
    u0(i) = 10*xj+5*sin(2*pi*xj)*sin(2*pi*xj);
end

rhs = @(t,u) k*(1/h^2)*A*u+k*(1/h^2)*b;

tic
[Ts, Xr] = ode45(rhs, [0:0.01:1], u0);
toc

figure(1), semilogy(1, tau), hold on;
xlabel('t');
ylabel('tau');
title("Tau values");
```

Using various values of n , we see that the higher that n gets, the closer and closer our time constant values approach .25 in the upper left value of τ . This is because our coefficient matrix helps approximate the temperature of each part more accurately if there are more parts to measure. The system seems to be decently stiff, with only the lowest values of n varying much, but as n approaches 100, the system seems to converge relatively quickly toward one solution.