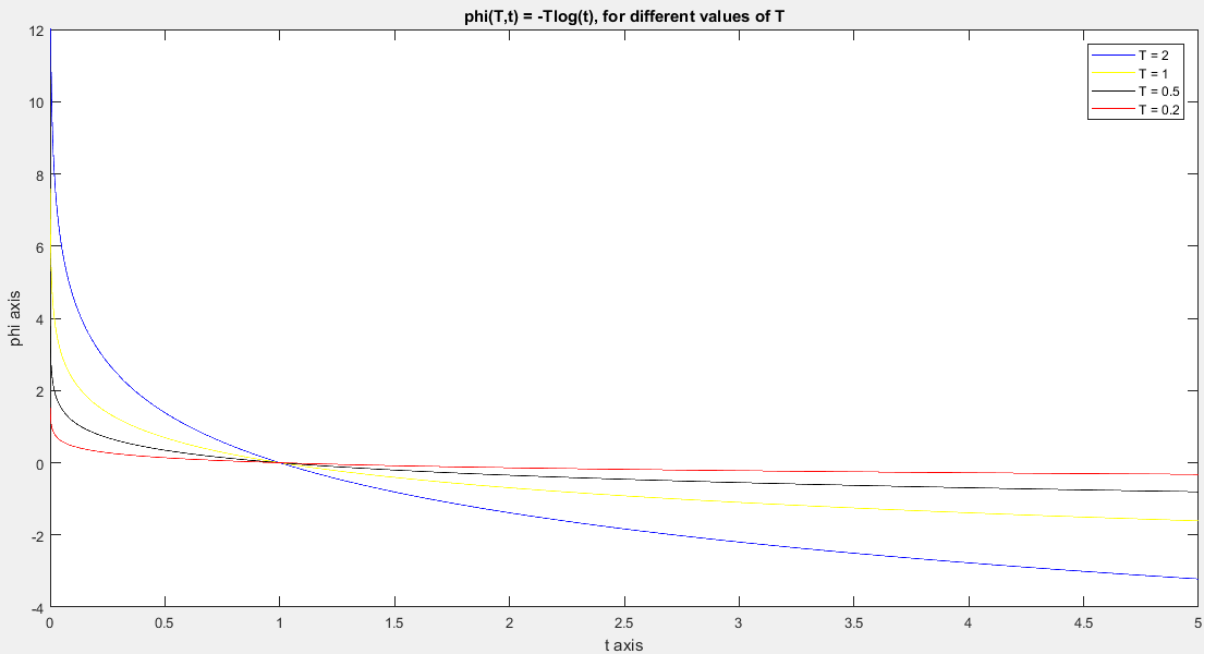
Question 7.

Q7. (a)



Code:

```
t=linspace(0,5,10000);
phi = log(t);
phi1 = (-2)*phi;
phi2 = -phi;
phi3 = -(0.5)*phi;
phi4 = -(0.2)*phi;
figure;

plot (t,phi1,'b');
hold on;
plot (t,phi2,'y');
hold on;
plot (t,phi3,'k');
hold on;
plot (t,phi4,'r');
hold on;
xlabel ('t axis');
ylabel ('phi axis');
title ('phi(T,t) = -Tlog(t), for different values of T');
xlim([0 5])
ylim([-4 12])
hold off;
legend('T = 2','T = 1','T = 0.5','T = 0.2');
```

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Q7. (e)

>> taumain

(The iterative values of xhat has been shown for each value of tau. The final values are shown in bold.)

Iteration number: 1
Value of tau: 1
The number of iterations: 151

xhat =

0.1890

0.1382

0.0739

0.8807

Iteration number: 2
Value of tau: 5.000000e-01
The number of iterations: 158

xhat =

0.1890 **0.1320**

0.1382 **0.1055**

0.0739 **0.0413**

0.8807 **0.8665**

Iteration number: 3
Value of tau: 2.500000e-01
The number of iterations: 138

xhat =

0.1890 0.1320 **0.0925**

0.1382 0.1055 **0.0793**

0.0739 0.0413 **0.0222**

0.8807 0.8665 **0.8784**

Iteration number: 4
Value of tau: 1.250000e-01
The number of iterations: 835

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xhat =

0.1890	0.1320	0.0925	**0.0651**
0.1382	0.1055	0.0793	**0.0586**
0.0739	0.0413	0.0222	**0.0116**
0.8807	0.8665	0.8784	**0.9004**

Iteration number: 5
Value of tau: 6.250000e-02
The number of iterations: 1564

xhat =

0.1890	0.1320	0.0925	0.0651	**0.0459**
0.1382	0.1055	0.0793	0.0586	**0.0427**
0.0739	0.0413	0.0222	0.0116	**0.0060**
0.8807	0.8665	0.8784	0.9004	**0.9230**

Iteration number: 6
Value of tau: 3.125000e-02
The number of iterations: 2953

xhat =

0.1890	0.1320	0.0925	0.0651	0.0459	**0.0324**
0.1382	0.1055	0.0793	0.0586	0.0427	**0.0308**
0.0739	0.0413	0.0222	0.0116	0.0060	**0.0030**
0.8807	0.8665	0.8784	0.9004	0.9230	**0.9424**

Iteration number: 7
Value of tau: 1.562500e-02
The number of iterations: 5596

xhat =

0.1890	0.1320	0.0925	0.0651	0.0459	0.0324	**0.0229**
0.1382	0.1055	0.0793	0.0586	0.0427	0.0308	**0.0221**
0.0739	0.0413	0.0222	0.0116	0.0060	0.0030	**0.0015**
0.8807	0.8665	0.8784	0.9004	0.9230	0.9424	**0.9577**

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Iteration number: 8
Value of tau: 7.812500e-03
The number of iterations: 10583

xhat =

0.1890	0.1320	0.0925	0.0651	0.0459	0.0324	0.0229	**0.0162**
0.1382	0.1055	0.0793	0.0586	0.0427	0.0308	0.0221	**0.0158**
0.0739	0.0413	0.0222	0.0116	0.0060	0.0030	0.0015	**0.0008**
0.8807	0.8665	0.8784	0.9004	0.9230	0.9424	0.9577	**0.9694**

Iteration number: 9
Value of tau: 3.906250e-03
The number of iterations: 19986

xhat =

0.1890	0.1320	0.0925	0.0651	0.0459	0.0324	0.0229	0.0162	**0.0114**
0.1382	0.1055	0.0793	0.0586	0.0427	0.0308	0.0221	0.0158	**0.0112**
0.0739	0.0413	0.0222	0.0116	0.0060	0.0030	0.0015	0.0008	**0.0004**
0.8807	0.8665	0.8784	0.9004	0.9230	0.9424	0.9577	0.9694	**0.9780**

Iteration number: 10
Value of tau: 1.953125e-03
The number of iterations: 19999

xhat =

0.1890	0.1320	0.0925	0.0651	0.0459	0.0324	0.0229	0.0162	0.0114	**0.0080**
0.1382	0.1055	0.0793	0.0586	0.0427	0.0308	0.0221	0.0158	0.0112	**0.0080**
0.0739	0.0413	0.0222	0.0116	0.0060	0.0030	0.0015	0.0008	0.0004	**0.0002**
0.8807	0.8665	0.8784	0.9004	0.9230	0.9424	0.9577	0.9694	0.9780	**0.9839**

>>

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Codes:

taumain.m

```
for i = 1:10
    tau = 2^(1-i);
    fprintf('Iteration number: %i\n', i);
    fprintf('Value of tau: %d\n', tau);
    if tau==1
        xxx = [1; 2; 3; 4];
        xhat(:,i) = tauf(tau,xxx)
    else
    xhat(:,i) = tauf(tau,xhat(:,i-1))
    end
end
```

tauf.m

```
function ret = tauf(taunum,xvect)
A = [1 -1 -1 0;2 0 3 0;-2 0 1 1;1 4 0 1;0 3 1 1];
y = [1;-1;1;2;0];
k = 1;
x(:,k) = xvect;

while (k < 20000)
d = 2*y'*A - 2*x(:,k)'*(A'*A) + taunum*[1/x(1,k) 1/x(2,k) 1/x(3,k)
1/x(4,k)];
d = d';
if (max(abs(d)) < (10^-4))
    break
end
a = 1;
 for i = 1:4
        x(i,k+1) = x(i,k) + a*d(i);
 end
while ((x(1,k+1) < 0)||(x(2,k+1) < 0)||(x(3,k+1) < 0)||(x(4,k+1) < 0))
    a = a/2;
    for i = 1:4
        x(i,k+1) = x(i,k) + a*d(i);
    end
end
pro(k) = x(1,k)*x(2,k)*x(3,k)*x(4,k);
pro(k+1) = x(1,k+1)*x(2,k+1)*x(3,k+1)*x(4,k+1);
fx(k+1) = -taunum*log(pro(k+1)) + (norm(y - A*x(:,k+1)))^2;
fx(k) = -taunum*log(pro(k)) + (norm(y - A*x(:,k)))^2;
while (fx(k+1) >= fx(k))
    a = a/2;
    for i = 1:4
        x(i,k+1) = x(i,k) + a*d(i);
    end
    pro(k+1) = x(1,k+1)*x(2,k+1)*x(3,k+1)*x(4,k+1);
    fx(k+1) = -taunum*log(pro(k+1)) + (norm(y - A*x(:,k+1)))^2;
end
    k = k+1;
end
ret = x(:,k-1);
fprintf('The number of iterations: %i\n\n', k-1)
end
```

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