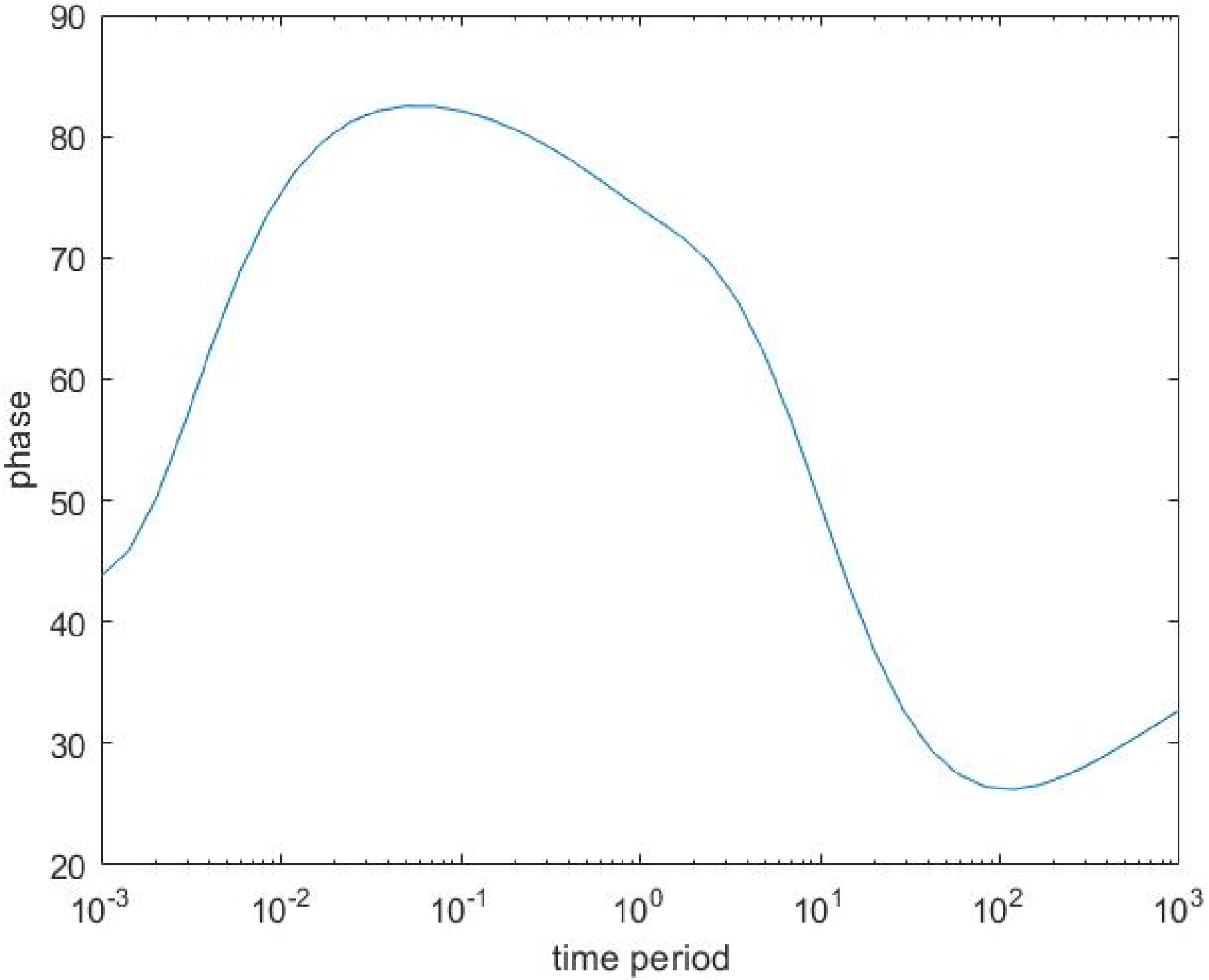
NAME: Utkarsh Jaiswal

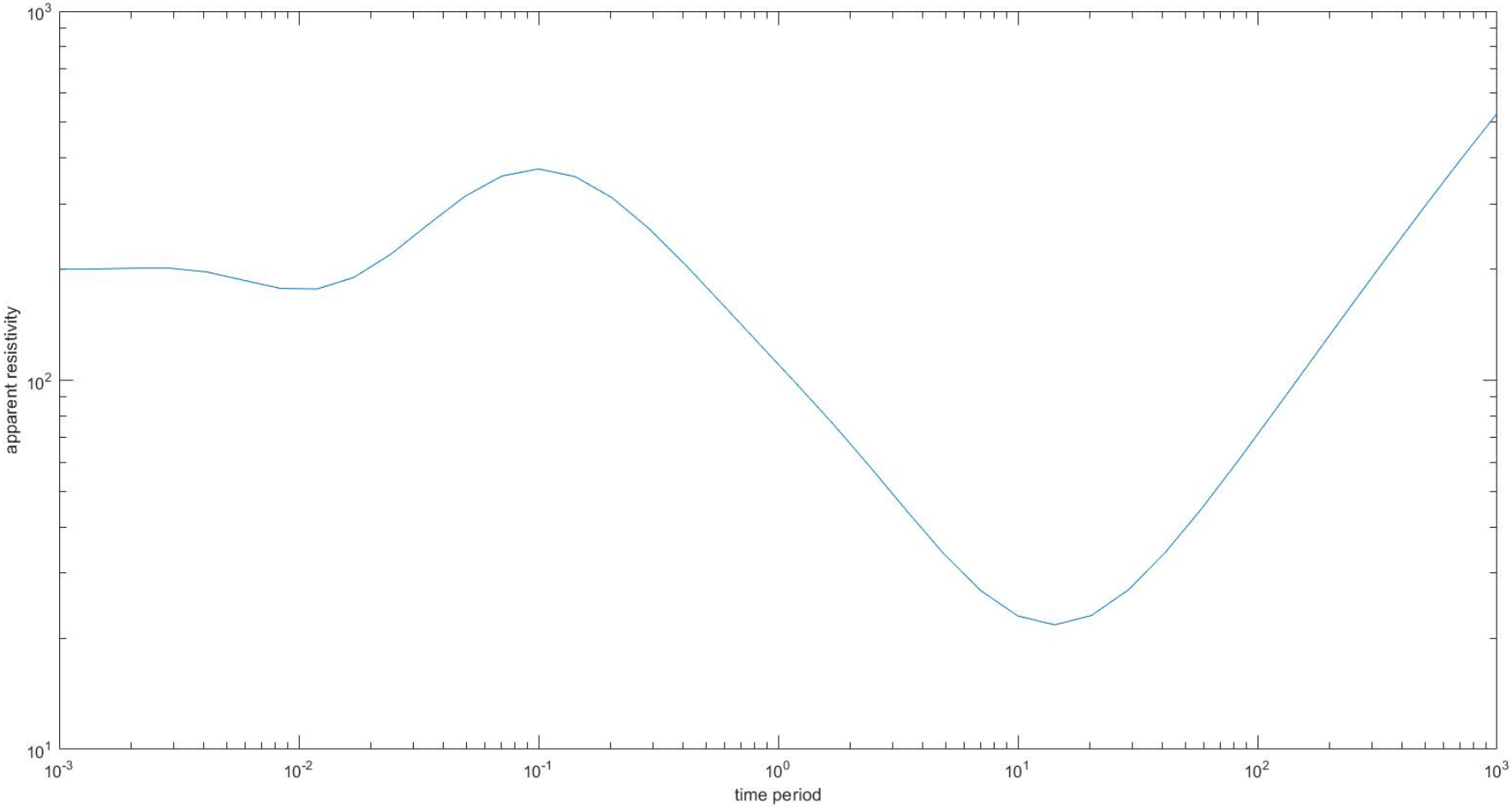
ROLL NO: 18EX20030

Lab Assignment

```
%18EX20030 UTKARSH JAISWAL
clear all
close all
clc
t=[0.001    0.001425    0.002031    0.002894    0.004125    0.005878    0.008377    0.011938    0.017013    0.024245    0.034551    0.049239    0.07017 0.1 0.14251 0.20309 0.28943 0.4
r=[199.93 200.15 201.18 201.27 196.55 186.62 177.37 176.7 190.1 219.7 263.79 314.72 357.31 373.79 356.03 311.99 257.43  204.81  160.24  125.07  97.754  75.917  58.135  44.119  33.804
ph=[43.797 45.874 50.234    56.265  62.784  68.722  73.519  77.087  79.573  81.184  82.115  82.513  82.49   82.122  81.463  80.548  79.404  78.04   76.478  74.846  73.301  71.729  69

loglog(t,r)
xlim([10^-3,10^3])
xlabel('time period')
ylabel('apparent resistivity')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
semilogx(t,ph)
xlim([10^-3,10^3]);
xlabel('time period')
ylabel('phase')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
```


90
80
70
60
50
40
30
20
phase
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
time period



The presented apparent resistivity and phase data are incompatible because as resistivity rises, phase rises with it, and when resistivity falls, phase falls with it. As a result, we'll analyse both sets of data individually.
Carefully observing the graph we can conclude it is 4 layer model. We may estimate different layer resistivities by carefully inspecting the apparent resistivity map. Because the plot starts at 200 ohm-m, Ro1 should be 200, and similarly for Ro2, Ro3, and Ro4.Similarly, we may estimate the initial values of each layer's thickness using the skin depth formula. Alternatively, we may set any thickness value (say, between 1000 and 3000) and then tweak the numbers to match the data by glancing at the forward plot.

```
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t=[0.001    0.001425    0.002031    0.002894    0.004125    0.005878    0.008377    0.011938    0.017013    0.024245    0.034551    0.049239    0.07017 0.1 0.14251 0.20309 0.28943 (
r=[199.93 200.15 201.18 201.27 196.55 186.62 177.37 176.7 190.1 219.7 263.79 314.72 357.31 373.79 356.03 311.99 257.43  204.81  160.24  125.07  97.754  75.917  58.135  44.119  33.8(
ph=[43.797 45.874 50.234    56.265  62.784  68.722  73.519  77.087  79.573  81.184  82.115  82.513  82.49   82.122  81.463  80.548  79.404  78.04   76.478  74.846  73.301  71.729  (

f=1./t;
om = 2*pi*f;
%putting initialvalus of rho and h
rho = [200 610 10 600];
h = [1000 1500 2100];
n = length(rho);
mu = 4*pi*10^(-7);
K = sqrt(j*om*mu);
for i = 1:length(f)
Z(n) = K(i)*sqrt(rho(n));
for p = n:-1:2
T(p-1) = K(i)*sqrt(rho(p-1))*tanh(K(i)*h(p-1)/(sqrt(rho(p-1))));
S(p-1) = tanh(K(i)*h(p-1)/(sqrt(rho(p-1))))/(K(i)*sqrt(rho(p-1)));
Z(p-1) = (Z(p) + T(p-1))/((Z(p)*S(p-1))+1);
end
pa(i) = (abs(Z(1))^2)/(om(i)*mu);
phase(i) = (180/pi)*angle(Z(1));
end
```
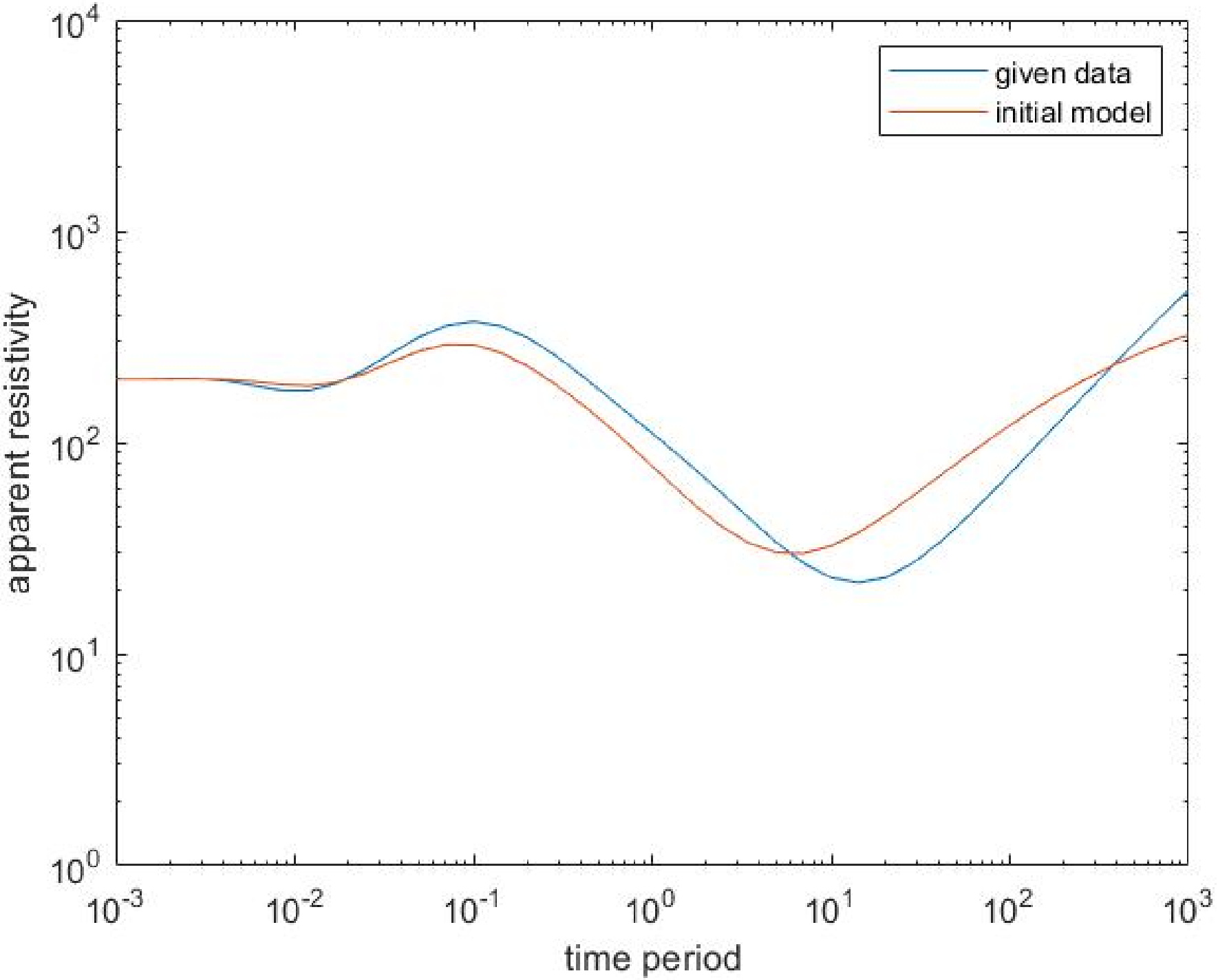

```
for i = 1:length(f)
Z(n) = K(i)*sqrt(rho(n));
for p = n:-1:2
T(p-1) = K(i)*sqrt(rho(p-1))*tanh(K(i)*h(p-1)/(sqrt(rho(p-1))));
S(p-1) = tanh(K(i)*h(p-1)/(sqrt(rho(p-1))))/(K(i)*sqrt(rho(p-1)));
Z(p-1) = (Z(p) + T(p-1))/((Z(p)*S(p-1))+1);
end
pa(i) = (abs(Z(1))^2)/(om(i)*mu);
phase(i) = (180/pi)*angle(Z(1));
end


e=0;
for i = 1:length(t);
   e=e+((r(i)-pa(i))/r(i))^2;
end
misfitrho=100*((e/length(t))^0.5)
loglog(t,r)
xlim([10^-3,10^3])
ylim([10^0,10^4])
hold on
loglog(t,pa);
xlim([10^-3,10^3]);
xlabel('time period')
ylabel('apparent resistivity')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
legend('given data','initial model ')
hold off
```

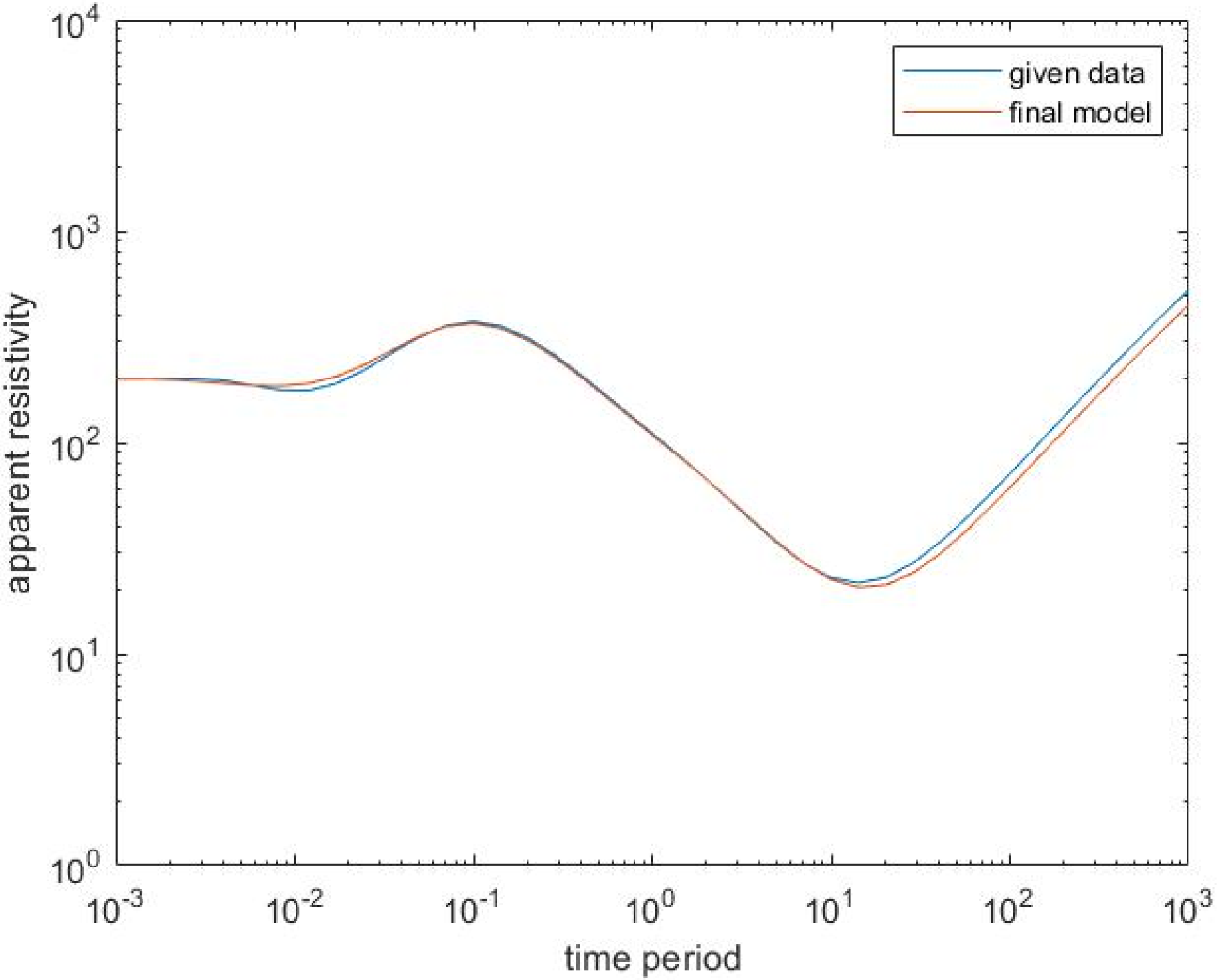
```
misfitrho =

   42.4373

>>
```


given data
initial model
apparent resistivity
time period
10^4
10^3
10^2
10^1
10^0
10^{-3}
10^{-2}
10^{-1}
10^0
10^1
10^2
10^3

```
%18EX20030 UTKARSH JAISWAL
clear all
close all
clc
t=[0.001    0.001425    0.002031    0.002894    0.004125    0.005878    0.008377    0.011938    0.017013    0.024245    0.034551    0.049239    0.07017 0.1 0.14251 0.20309 0.2894
r=[199.93 200.15 201.18 201.27 196.55 186.62 177.37 176.7 190.1 219.7 263.79 314.72 357.31 373.79 356.03 311.99 257.43  204.81  160.24  125.07  97.754  75.917  58.135  44.119  33
ph=[43.797 45.874 50.234    56.265  62.784  68.722  73.519  77.087  79.573  81.184  82.115  82.513  82.49   82.122  81.463  80.548  79.404  78.04   76.478  74.846  73.301  71.729

f=1./t;
om = 2*pi*f;
%putting initialvalus of rho and h
rho = [200 590 10 8000];
h = [700 2300 4300];
n = length(rho);
mu = 4*pi*10^(-7);
K = sqrt(j*om*mu);
for i = 1:length(f)
Z(n) = K(i)*sqrt(rho(n));
for p = n:-1:2
T(p-1) = K(i)*sqrt(rho(p-1))*tanh(K(i)*h(p-1)/(sqrt(rho(p-1))));
S(p-1) = tanh(K(i)*h(p-1)/(sqrt(rho(p-1))))/(K(i)*sqrt(rho(p-1)));
Z(p-1) = (Z(p) + T(p-1))/((Z(p)*S(p-1))+1);
end
pa(i) = (abs(Z(1))^2)/(om(i)*mu);
phase(i) = (180/pi)*angle(Z(1));
end
```

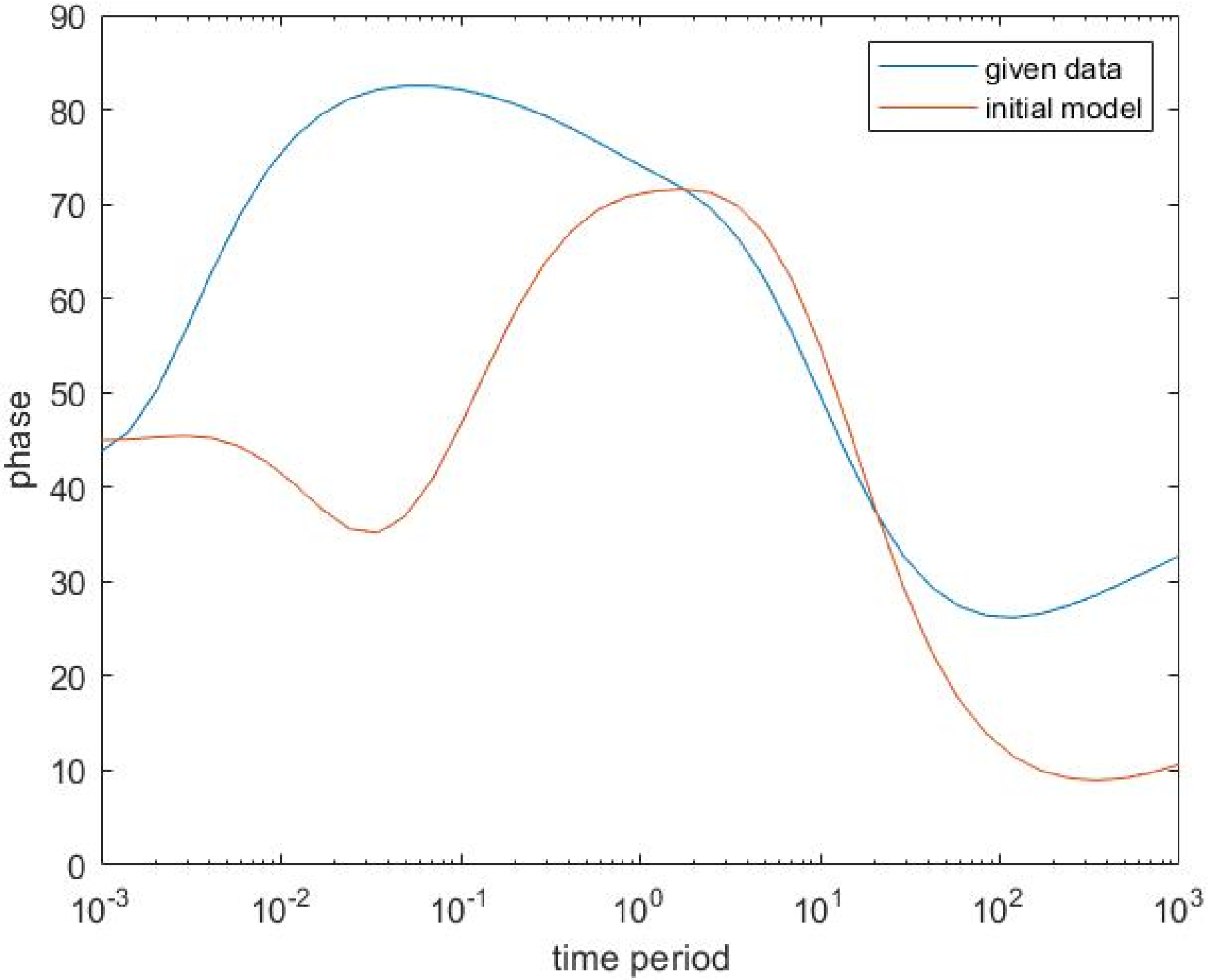
```
K = sqrt(j*om*mu);
for i = 1:length(f)
Z(n) = K(i)*sqrt(rho(n));
for p = n:-1:2
T(p-1) = K(i)*sqrt(rho(p-1))*tanh(K(i)*h(p-1)/(sqrt(rho(p-1))));
S(p-1) = tanh(K(i)*h(p-1)/(sqrt(rho(p-1))))/(K(i)*sqrt(rho(p-1)));
Z(p-1) = (Z(p) + T(p-1))/((Z(p)*S(p-1))+1);
end
pa(i) = (abs(Z(1))^2)/(om(i)*mu);
phase(i) = (180/pi)*angle(Z(1));
end


e=0;
for i = 1:length(t);
   e=e+((r(i)-pa(i))/r(i))^2;
end
misfitrho=100*((e/length(t))^0.5)
loglog(t,r)
xlim([10^-3,10^3])
ylim([10^0,10^4])
hold on
loglog(t,pa);
xlim([10^-3,10^3]);
xlabel('time period')
ylabel('apparent resistivity')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
legend('given data','final model ')
hold off
```

```
misfitrho =

    7.8088

>>
```


given data
final model
apparent resistivity
time period
10^4
10^3
10^2
10^1
10^0
10^{-3}
10^{-2}
10^{-1}
10^0
10^1
10^2
10^3

```
e=0;
for i = 1:length(t);
  e=e+((ph(i)-phase(i))/ph(i))^2;
end
misfitphase=100*((e/length(t))^0.5)
semilogx(t,ph)
ylim([0,90])
hold on
semilogx(t,phase);
xlim([10^-3,10^3]);
xlabel('time period')
ylabel('phase')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
legend('given data','initial model ')
```

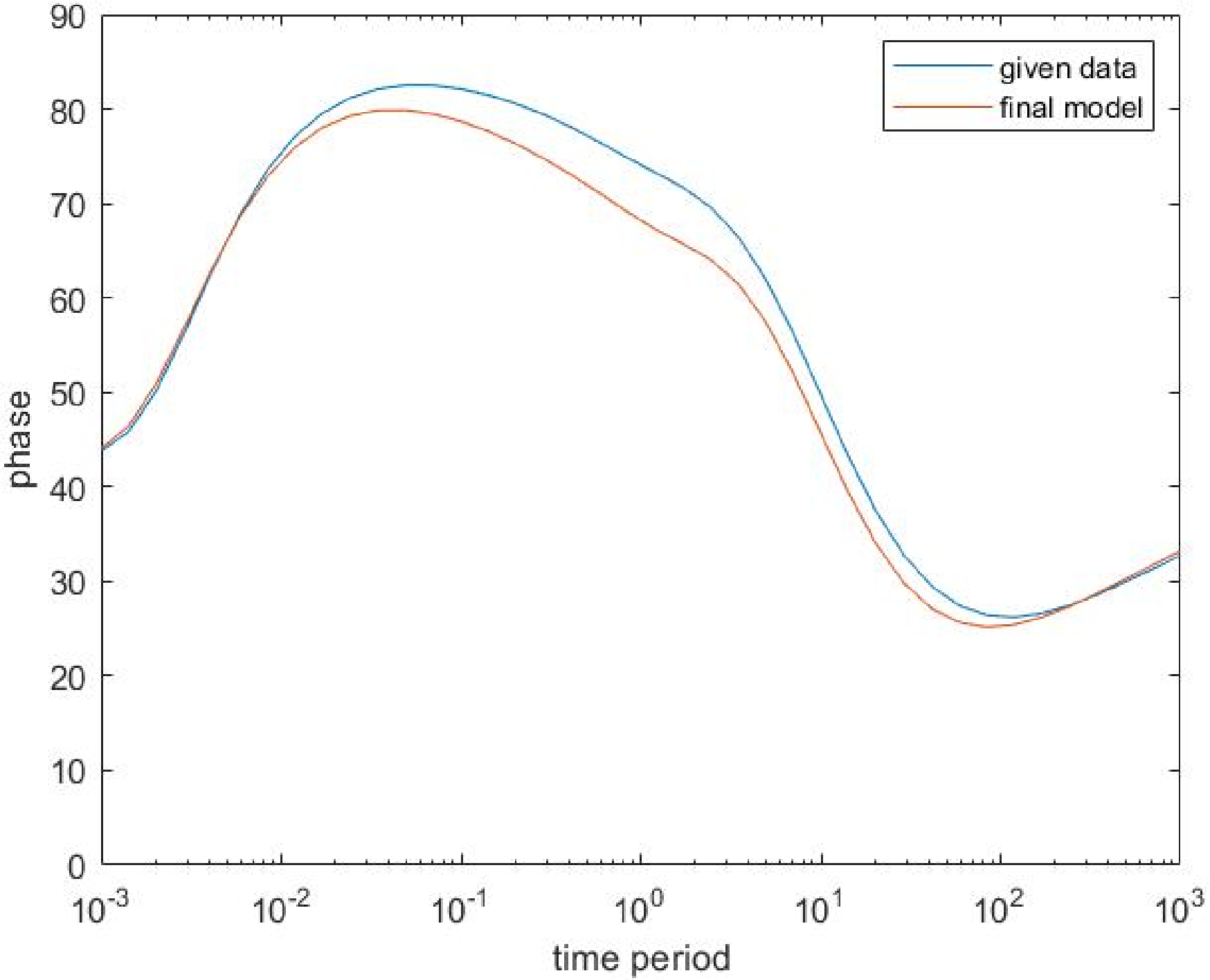
```
misfitphase =

   38.9674

>>
```


given data
initial model
phase
time period
90
80
70
60
50
40
30
20
10
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}

```
%18EX20030 UTKARSH JAISWAL
clear all
close all
clc
t=[0.001    0.001425    0.002031    0.002894    0.004125    0.005878    0.008377    0.011938    0.017013    0.024245    0.034551    0.049239    0.07017 0.1 0.14251 0.20309 0.28
r=[199.93 200.15 201.18 201.27 196.55 186.62 177.37 176.7 190.1 219.7 263.79 314.72 357.31 373.79 356.03 311.99 257.43  204.81  160.24  125.07  97.754  75.917  58.135  44.119
ph=[43.797 45.874 50.234    56.265  62.784  68.722  73.519  77.087  79.573  81.184  82.115  82.513  82.49   82.122  81.463  80.548  79.404  78.04   76.478  74.846  73.301  71.7

f=1./t;
om = 2*pi*f;
%putting initialvalus of rho and h
rho = [990 5 290 80];
h = [860 3190 9900];
n = length(rho);
mu = 4*pi*10^(-7);
K = sqrt(j*om*mu);
for i = 1:length(f)
Z(n) = K(i)*sqrt(rho(n));
for p = n:-1:2
T(p-1) = K(i)*sqrt(rho(p-1))*tanh(K(i)*h(p-1)/(sqrt(rho(p-1))));
S(p-1) = tanh(K(i)*h(p-1)/(sqrt(rho(p-1))))/(K(i)*sqrt(rho(p-1)));
Z(p-1) = (Z(p) + T(p-1))/((Z(p)*S(p-1))+1);
end
pa(i) = (abs(Z(1))^2)/(om(i)*mu);
phase(i) = (180/pi)*angle(Z(1));
end
```

```
e=0;
for i = 1:length(t);
  e=e+((ph(i)-phase(i))/ph(i))^2;
end
misfitphase=100*((e/length(t))^0.5)
semilogx(t,ph)
ylim([0,90])
hold on
semilogx(t,phase);
xlim([10^-3,10^3]);
xlabel('time period')
ylabel('phase')
xticks([10^-3 10^-2 10^-1 10^0 10^1 10^2 10^3]);
legend('given data','final model ')
```

```
misfitphase =

    5.3048

>>
```


given data
final model
phase
time period
90
80
70
60
50
40
30
20
10
0
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}

Table

Model Parameters	Initial Apparent Resistivity Model	Final Apparent Resistivity Model	Initial Phase Model	Final Phase Model
Rho1	200	200	210	990
Rho2	610	590	580	5
Rho3	10	10	11	290
Rho4	600	8000	7000	80
H1	1000	700	650	860
H2	1500	2300	2000	3190
H3	2100	4300	4200	9900
%Misfit Error	42.4373	7.8088	38.9674	5.3048