

***Proiect la Identificarea Sistemelor***

**IDENTIFICAREA MODELULUI DINAMIC AL**

**PROCESELOR DE ORDINUL II**

Coordonator Student

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**Capitolul 1**

***Identificarea unui circuit electric***

**1.1 Obtinerea datelor experimentale**

**1.1.1 Introducere:**

Se considera circuitul electric din fig. 1.1, avand urmatoarele caracterstici electrice:



1. Ua = 10 [V];
2. Uin  [-Ua; Ua];
3. Uout  [-Ua; Ua];

Aparatura utilizata: sursa de alimentare, multimetru, generator de semnal, osciloscop (vezi figura 1.2).

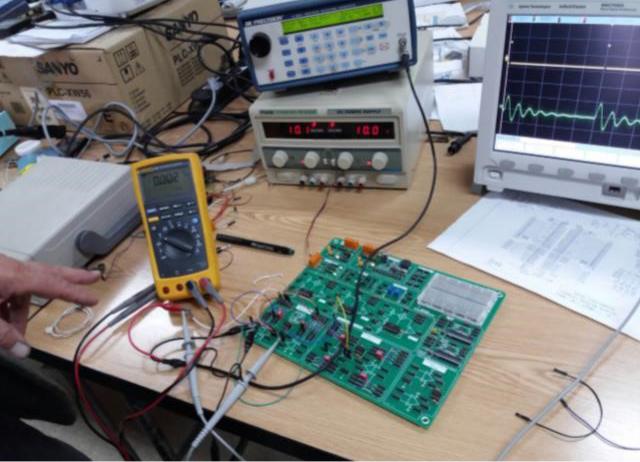


fig. 1.2: Aparatura utilizata

**1.1.2 Achizitia datelor intrare-iesire**

Utilizand aparatura din dotare se vor genera semnalele necesare identificarii experimentale a circuitului electric‚ si se vor achizitiona datele intrare-iesire in vederea procesarii ulterioare.

**1.1.3 Desfasurarea experimentelor**

1. Se alimenteaza circuitul.
2. Se efectueaza urmatoarele experimente:

**Experiment I**

A.1 Se genereaza un semnal de tip treapta avand caracteristicile corelate cu dinamica circuitului electric‚ si tensiunea de alimentare a acestuia;

A.2 Se vizualizeaza‚ si se masoara sincron intrarea‚ si iesirea circuitului, obtinnd datele experimentale: [tk; uk; yk], k = 1;2; ...

**Experiment II**

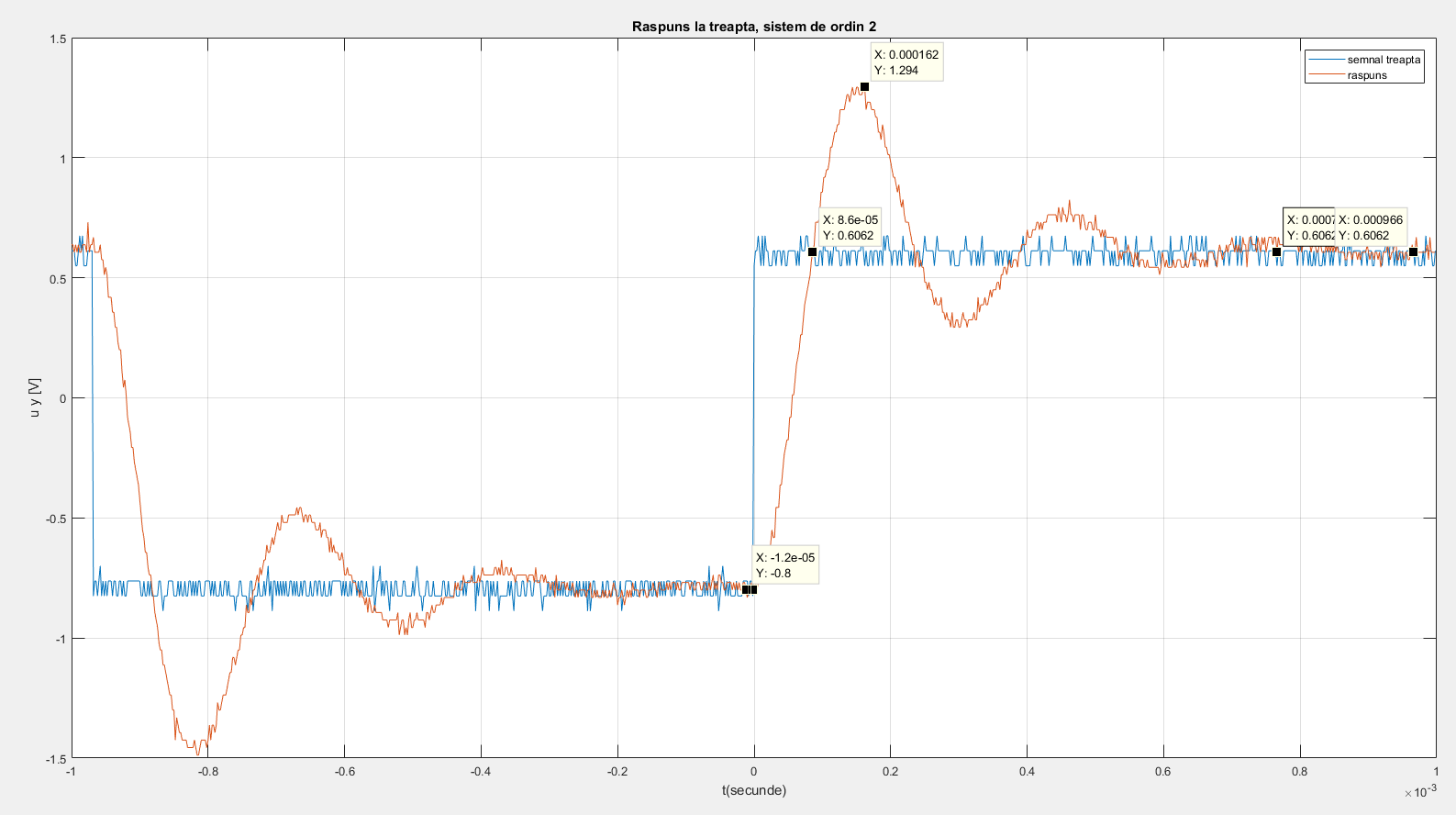
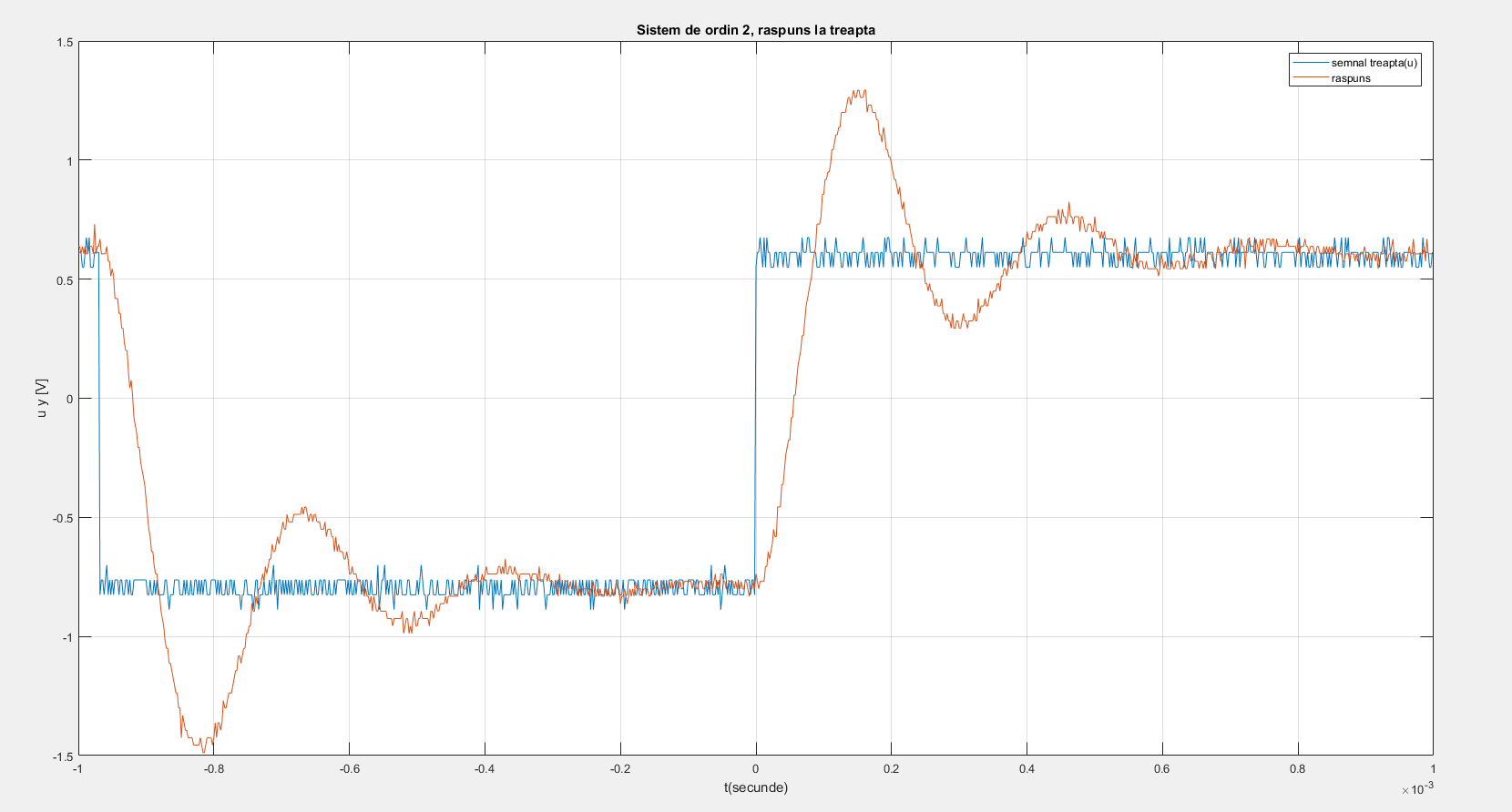
B.1 Se genereaza un semnal de tip impuls avand caracteristicile corelate cu dinamica circuitului electric‚ si tensiunea de alimentare a acestuia; B.2 Se vizualizeaza‚ si se masoara sincron intrarea‚ si iesirea circuitului, obtinnd datele experimentale: [tk; uk; yk], k = 1;2; ...

**1.2 Procesarea datelor experimentale**

Vizualizarea datelor experimentale utilizand : MS Excel, Matlab, etc. In functie de datele experimentale obtinute ([ , , ] k=1,2,....) se pot efectua urmatoareleoperatii: filtrare antidistorsiune de tip medie alunecatoare, eliminarea componentelor continue stationare sau cvasistationare, scalarea intrarilor si iesirilor. Se va determina functia de transfer a unui model de ordinul doi pe baza raspunsului la semnal de tip impuls real si semnal de tip treapta.

**Experiment I**

**Intrarea si iesirea unui sistem de ordinul II (TREAPTA)**



In vederea stabilirii conditiilor initiale nenule, valorilor de regim stationar, factorului de proportionalitate, valoarea suprareglajului, valoarea factorului de amortizate si a pulsatiei naturale, citesc de pe figura 1.4 urmatoarele date:

t1=884;t2=984;ti1=494;ti2=500;ti3=544;ti4=582;

Utilizand valorile extrase din grafic, calculam:

1.Valoarea intrari si iesire regim stationar:

ust=mean(u(t1:t2)); ust=0.598886090613862V

yst=mean(y(t1:t2)); yst=0.614913354336634V

2.Factor de proportionalitate:

k= k=1.026761789886195;

3.Suprareglaj:

sigma= sigma=0.461010118518835;

4.Factor de amortizare:

tita=0.239316317920612;

5.Perioada oscilatie:

tosc=2(Tmax-T0) tosc=1.520000000000000e-04

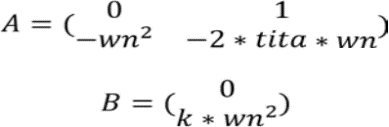
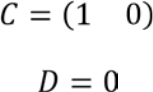
6.Pulsatia naturala:

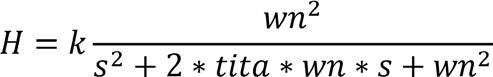
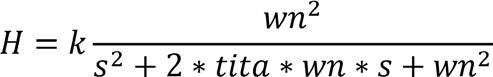
wn= wn=2.128693581788111e+04;

7.Functia de transfer:

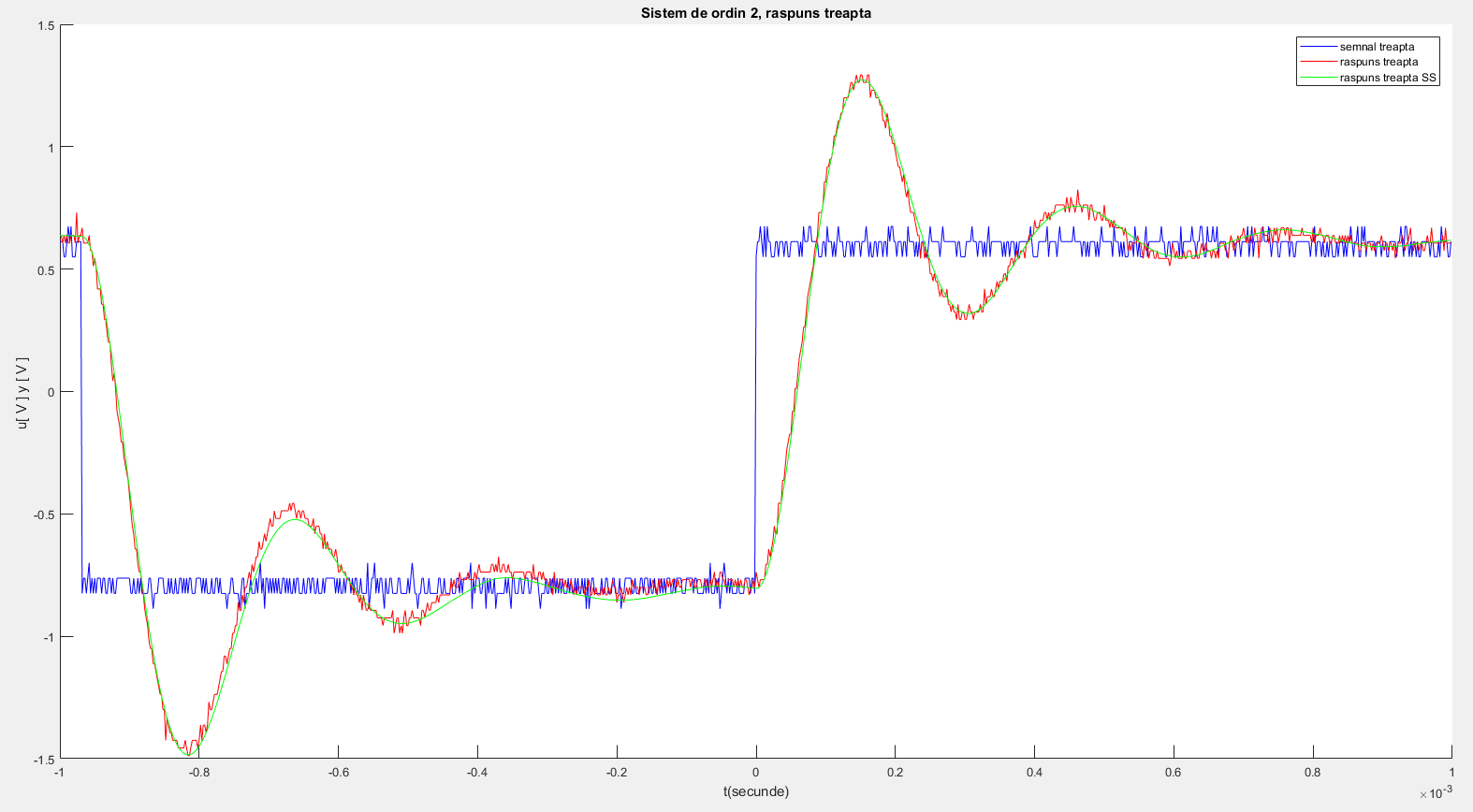
H=k H=

8.Spatiu starilor:





Raspunsul sistemului folosind spatiul starilor:



9. Eroarea medie patratica la treapta:

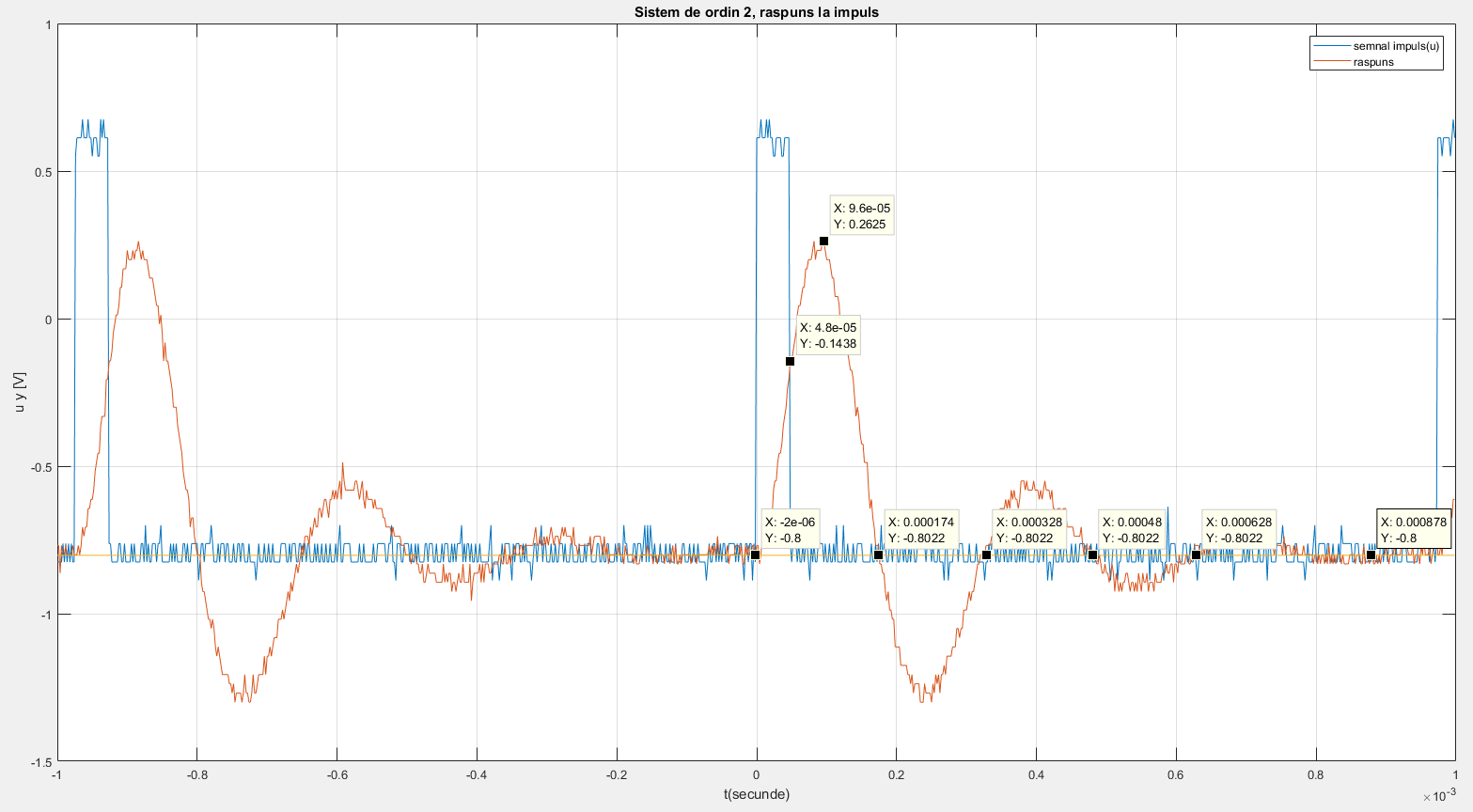
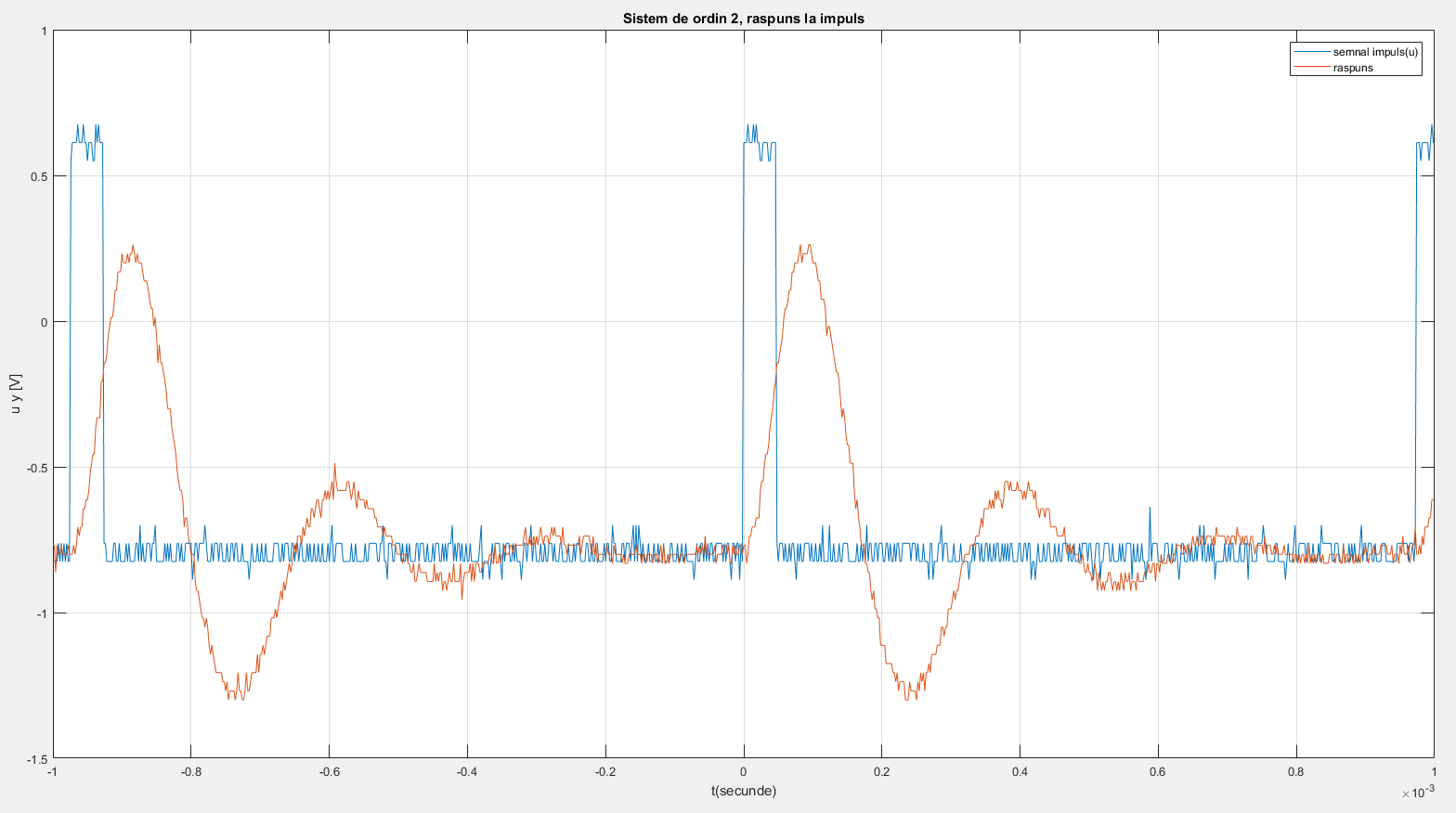
J=sqrt(1/1000\*(sum(y-yc).^2)) J= 0.035526630838636;

10. Eroare medie patratica normalizata:

Empn= norm(y-ycalculat)/norm(y-ym) Empn= 0.114855186678711;

**Experiment II**

**Intrarea si iesirea unui sistem de ordinul II (Impuls)**



Utilizand valorile extrase din grafic, calculam:

1.Valoarea intrari si iesire regim stationar:

ust=mean(u(882:992)); ust=-0.794059453940595 V

yst=mean(y(882:992)); yst=-0.802165853584158 V

2.Factor de proportionalitate:

k= k=1.010208806914059;

3.Suprareglaj:

A1=sum(y(623:694)-yst)\*(t(2)-t(1));

A2=sum(y(694:788)-yst)\*(t(2)-t(1));

sigma=-A2/A1 sigma=0.486025580293688;

4.Factor de amortizare:

tita=0.223831734802742;

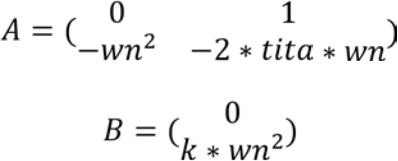
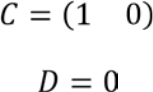
5.Pulsatia naturala:

wn= wn=2.120642634667262e+04;

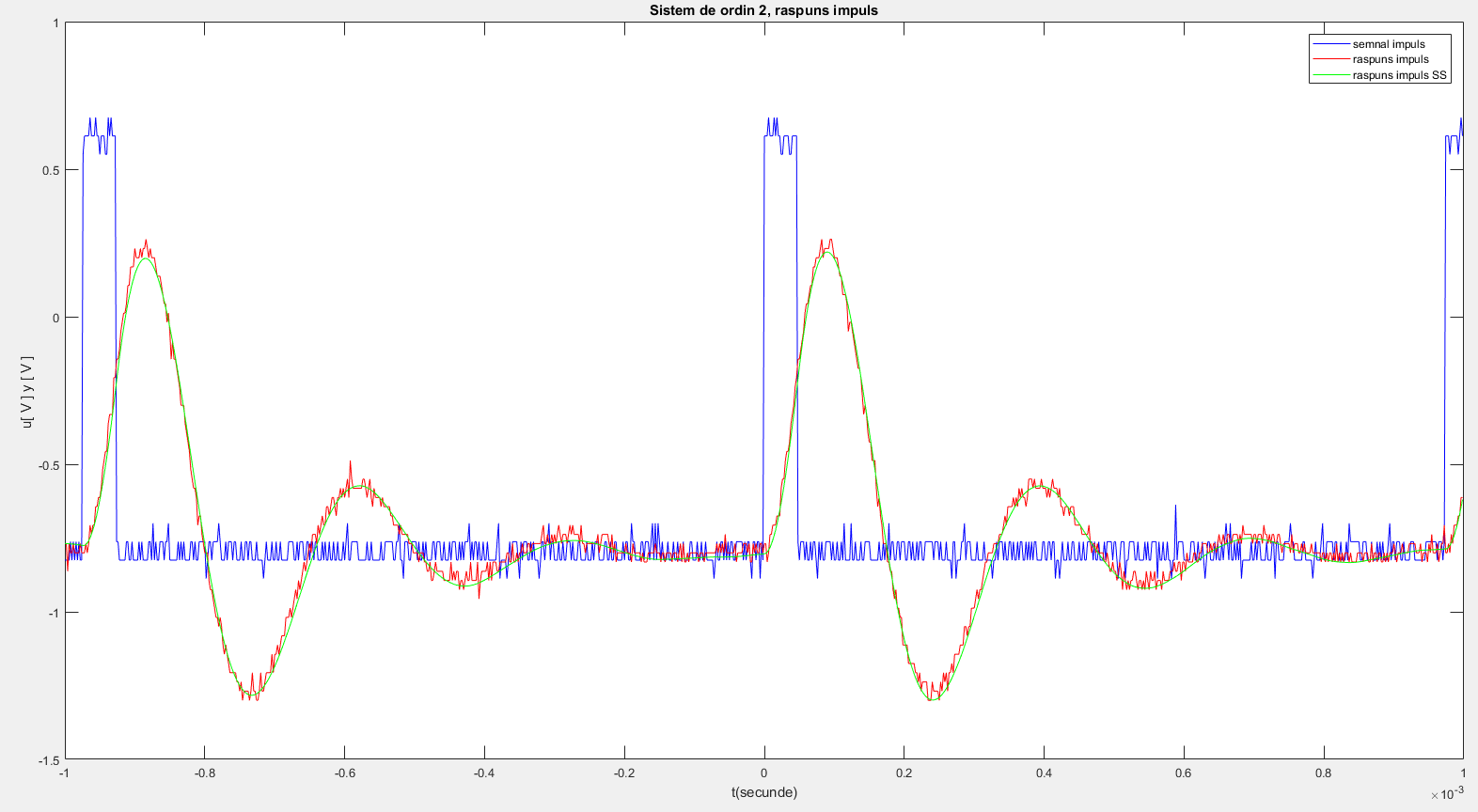
6.Functia de transfer:

H=k H=

7.Spatiu starilor:



Raspunsul sistemului folosind spatiul starilor:



9. Eroarea medie patratica la treapta:

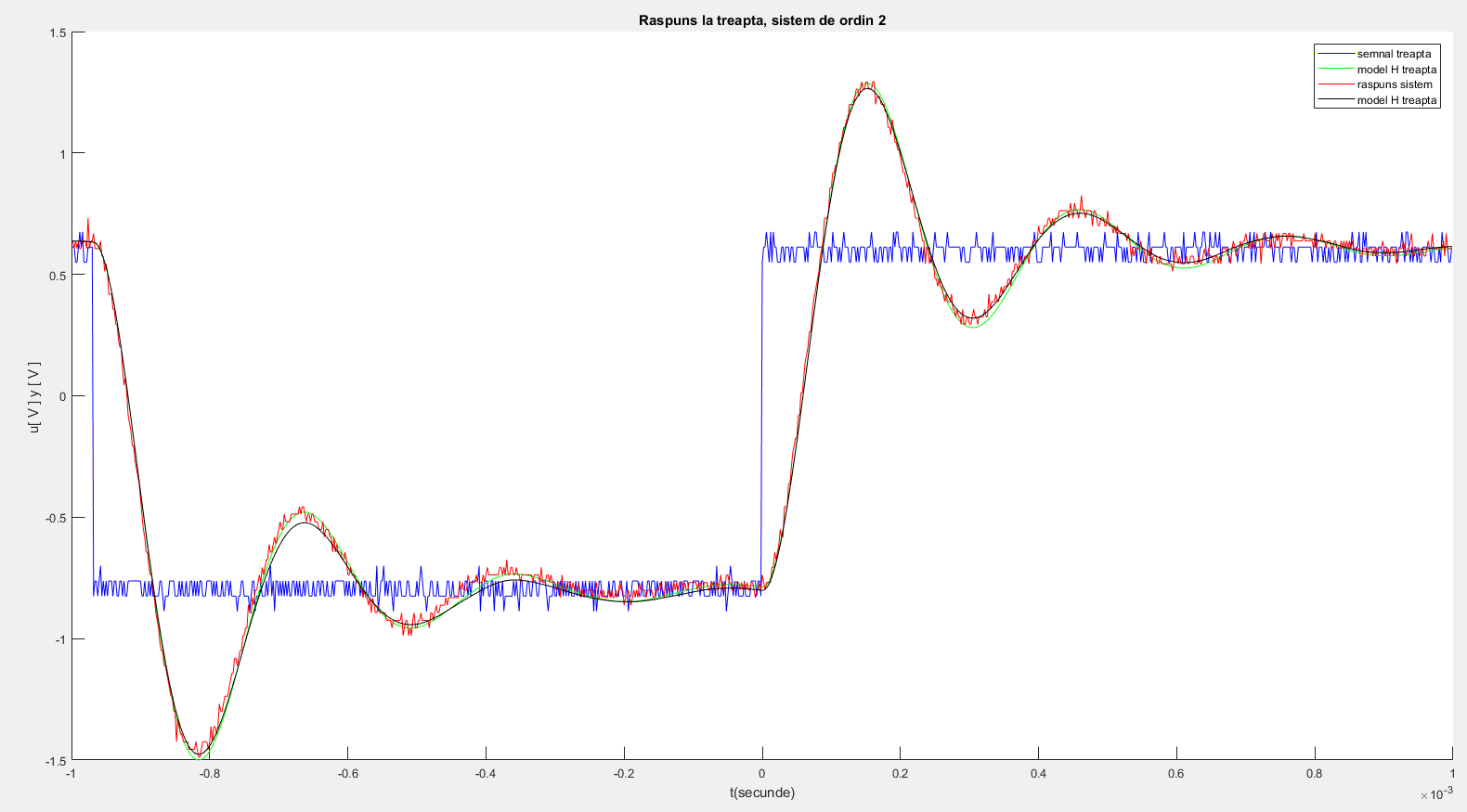
J=sqrt(1/1000\*(sum(y-yc).^2)) J= 0.031311421395378;

10. Eroare medie patratica normalizata:

Empn= norm(y-ycalculat)/norm(y-ym) Empn= 0.041344094126011;

**1.2.1.** **Validarea modelului**

1. Folosind functia de transfer identificata la impuls am simulat raspunsul sistemului la treapta.



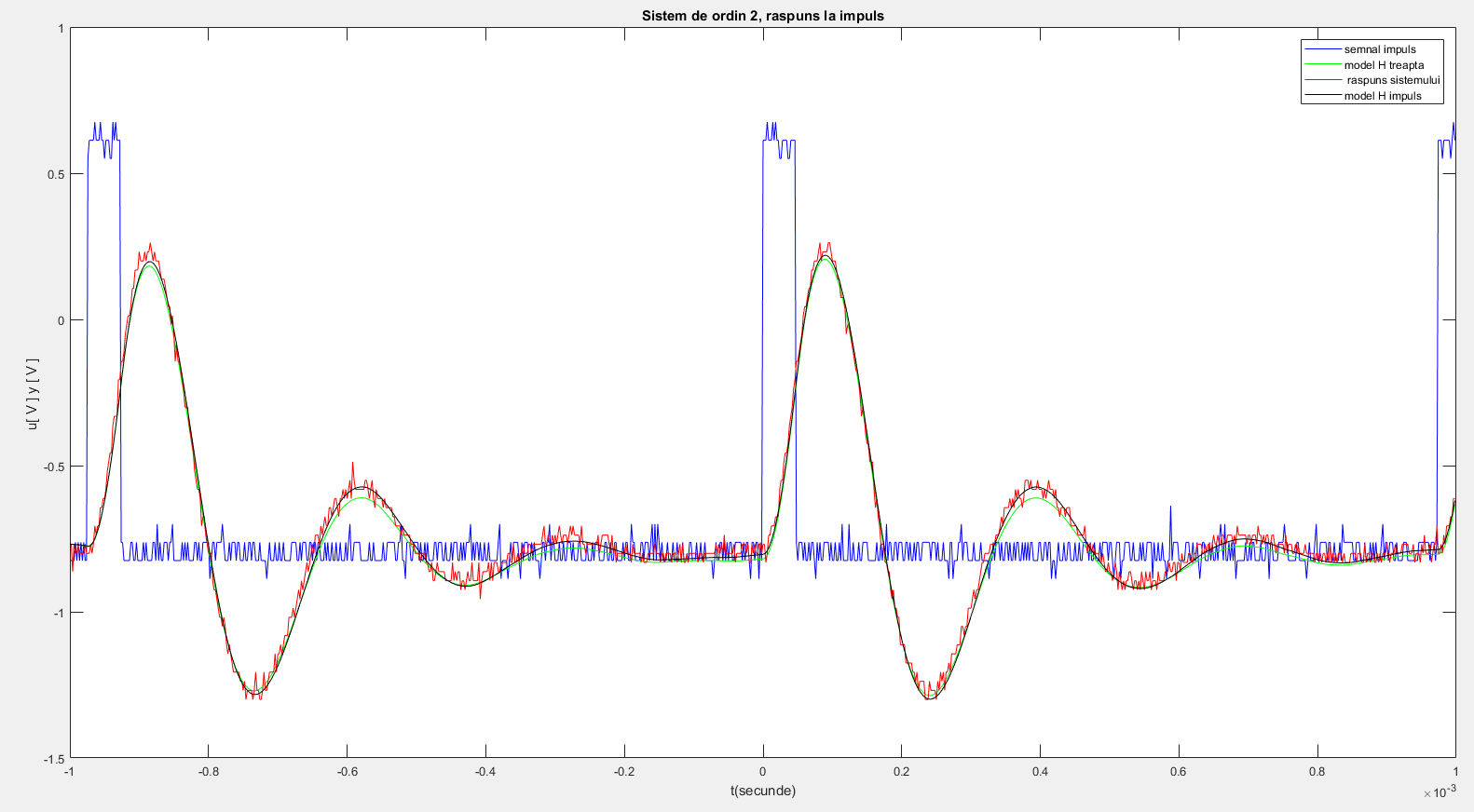
*Eroare medie patratica* : 0.033244054425541

*Eroare medie patratica la impuls* : 0.031311421395378

*Eroare medie normalizata* : 0.043895973227926

*Eroare medie normalizata la impuls* : 0.041344094126011

1. Folosind functia de transfer identificata la treapta am simulat raspunsul sistemului la impuls.



*Eroare medie patratica* : 0.029112962280081

*Eroare medie patratica la treapta* : 0.035526630838636

*Eroare medie normalizata* : 0.094120231457821

*Eroare medie normalizata la treapta* : 0.114855186678711

Concluzie : se alege semnalul **impuls**.

**Cod sursa treapta**

t=second2;

u=Volt2;

y=Volt3;

% plot(t,[u,y]); grid

% xlabel('t(secunde)');ylabel('u y [V]');

% legend('semnal treapta','raspuns');

% title('Raspuns la treapta, sistem de ordin 2');

% Timpi inainte de treapta

ti1=494; ti2=500;

% Max si min

u0=mean(u(ti1:ti2)); y0=mean(y(ti1:ti2)); t0=t(544);

ymax=y(582); tmax=t(582);

% Regim stationar

ust=mean(u(884:984)); yst=mean(y(884:984))

% Factorul de proportionalitate

k=(yst-y0)/(ust-u0);

% Suprareglaj

sigma=(ymax-yst)/(yst-y0)

%Amortizare

tita=-(log(sigma))/(sqrt(log(sigma)^2+pi^2))

%Oscilatie

Tosc=2\*(tmax-t0)

%Pulsatie naturala

wn=pi/(Tosc\*sqrt(1-tita^2))

% Functia de transfer

H=tf(k\*wn^2, [1 2\*tita\*wn wn^2])

A=[0 1; -wn^2 -2\*tita\*wn]

B=[0 ; k\*wn^2];

C=[1 0]; D=0;

% Y calculat

sys=ss(A,B,C,D);

hold on

yc=lsim(sys,u,t,[y(1) ;0]);

% plot(t,u,'b',t,y,'r',t,yc,'green');

% xlabel('t(secunde)');ylabel('u[ V ] y [ V ] ');

% legend('semnal treapta','raspuns treapta','raspuns treapta SS');

% title('Sistem de ordin 2, raspuns treapta');

%Eroare medie patratica

J=sqrt(1/1000\*sum((y-yc).^2));

%Eroare medie normalizata

ym=mean(y); Empn=norm(y-yc)/norm(y-ym);

%Functia de transfer identificata la impuls

wn\_imp= 2.120642634667262e+04;

tita\_imp= 0.223831734802742;

k\_imp=1.010208806914059;

A\_imp=[0 1; -wn\_imp^2 -2\*tita\_imp\*wn\_imp];

B\_imp=[0 ; k\_imp\*wn\_imp^2];

C\_imp=[1 0]; D\_imp=0;

sys\_imp=ss(A\_imp,B\_imp,C\_imp,D\_imp);

yc\_imp=lsim(sys\_imp,u,t,[y(1) ;0]);

plot(t,u,'b',t,yc\_imp,'green',t,y,'r',t,yc,'black');

legend('semnal treapta','model H treapta','raspuns sistem ','model H treapta');

xlabel('t(secunde)');ylabel('u[ V ] y [ V ] ');

title('Raspuns la treapta, sistem de ordin 2');

%Eroare medie patratica la impuls

J\_imp=sqrt(1/1000\*sum((y-yc\_imp).^2))

%Eroare medie normalizata

ym=mean(y); Empn\_imp=norm(y-yc\_imp)/norm(y-ym)

**Cod sursa impuls**

t=second1;

u=Volt;

y=Volt1;

% plot(t,[u,y yst\*ones(size(t))]); grid

% xlabel('t(secunde)');ylabel('u y [V]');

% legend('semnal impuls','raspuns');

% title('Raspuns la impuls, sistem de ordin 2');

%Regim stationar

ust=mean(u(882:982))

yst=mean(y(882:982))

%Factorul de proportionalitate

k=yst/ust

%Suprareglajul

A1=sum(y(623:694)-yst)\*(t(2)-t(1));

A2=sum(y(694:788)-yst)\*(t(2)-t(1));

sigma=-A2/A1

%Factorul de amortizare

tita=-log(sigma)/sqrt(log(sigma)^2+pi^2)

%Perioada de oscilatie

tmax=t(538);

t0=t(500);

Tosc=2\*(tmax-t0)

%Pulsatie naturala

wn=pi/(Tosc\*(sqrt(1-tita^2)))

%Functia de transfer

H=tf(k\*wn^2,[1 2\*tita\*wn wn^2])

%Spatiul starilor

A=[0 1;-wn^2 -2\*tita\*wn];

B=[0;k\*wn^2];

C=[1 0]; D=0;

sys=ss(A,B,C,D);

yc=lsim(sys,u,t,[y(1);0]);

% plot(t,u,'b',t,y,'r',t,yc,'green');

% xlabel('t(secunde)');ylabel('u[ V ] y [ V ] ');

% legend('semnal impuls','raspuns impuls','raspuns impuls SS');

% title('Sistem de ordin 2, raspuns impuls');

%Eroare medie patratica

J=sqrt(1/1000\*sum((y-yc).^2));

%Eroare medie patratica normalizata

ym=mean(y);

Empn=norm(y-yc)/norm(y-ym);

% %Functia de transfer identificata la treapta

wn\_tr= 2.128693581788111e+04;

tita\_tr= 0.239316317920612;

k\_tr=1.026761789886195;

A\_tr=[0 1; -wn\_tr^2 -2\*tita\_tr\*wn\_tr];

B\_tr=[0 ; k\_tr\*wn\_tr^2];

C\_tr=[1 0]; D\_tr=0;

sys\_tr=ss(A\_tr,B\_tr,C\_tr,D\_tr);

yc\_tr=lsim(A\_tr,B\_tr,C\_tr,D\_tr,u,t,[y(1) ;0]);

plot(t,u,'b',t,yc\_tr,'green',t,y,'r',t,yc,'black');

legend('semnal impuls','model H treapta ',' raspuns sistemului ','model H impuls');

xlabel('t(secunde)');ylabel('u[ V ] y [ V ] ');

title('Sistem de ordin 2, raspuns la impuls');

% eroare medie patratica la treapta

J\_tr=sqrt(1/1000\*(sum((y-yc\_tr).^2)))

%eroare medie normalizata

ym=mean(y);

Empn\_tr=norm(y-yc\_tr)/norm(y-ym);