Ex1.a.

//AB1 ordin 2

```
echo off;
global kp tp zeta u;//ord 2; ord1: kp tp u; ord1sin: kp tp a omega;
//2poli 1zero: kp t1 t2 t3 u
kp=1;tp=2;zeta=0.3;tf=40;h=0.01;q=0.1;
u=1;t0=0;y10=0;y20=0;
t(1)=t0;
y(1,1)=y10;y(1,2)=y20;//ord2; ord1: y(1)=y0;
uc(1)=u;//treapta; sin: uc(1)=0
tc=t0;
yc2=[y10 y20];//ord2; ord1: yc2 = y0
yc1=yc2+h*ord2a(tc,yc2); //in functie de formula RK
tc=tc+h;
for i=2:q/h
    yc=yc1+h*(3*ord2a(tc,yc1)-ord2a(tc-h,yc2))/2; //formula AB, yk+1
//devine yc, yk devine yc1, yk-1 devine yc2, yk-2 devine yc3, yk-3
//devine yc4
    tc=tc+h;yc2=yc1;yc1=yc;
end;
t(2)=tc;
y(2,1)=yc(1);y(2,2)=yc(2);//ord2; ord1: y(2)=yc
uc(2)=u;//treapta; sin: uc(2)=a*sin(omega*tc)
for k=3:(tf-t0)/q+1
    for i=1:q/h
     yc=yc1+h*(3*ord2a(tc,yc1)-ord2a(tc-h,yc2))/2;//formula AB
    tc=tc+h;yc2=yc1;yc1=yc;
end;
t(k)=tc;
y(k,1)=yc(1);y(k,2)=yc(2);//ord2, ord1: y(k)=yc
uc(k)=u;//treapta; sin: uc(k)=a*sin(omega*tc)
end;
clf;

subplot(211);//doar la ord2
plot(t,y(:,1),'-r',t,uc,'-b');//ord2, ord1: plot(t,y,'-r',t,uc,'-b');
grid;
title('raspuns sistem ordin doi');
subplot(212);//doar la ord2
plot(t,y(:,2),'-r');//doar la ord2
grid;
title('derivata raspuns sistem ordin doi');
```

//AB3 ordin 1

```
echo off;
global kp tp u;
t(1)=t0;
y(1)=y0;uc(1)=u;
tc=t0;
yc4=y0;
k0=h*ord1(tc,yc4);
k1=h*ord1(tc+h,yc4+k0);
```

```
yc3=yc4+(k0+k1)/2;
tc=tc+h;
k0=h*ord1(tc,yc3);
k1=h*ord1(tc+h,yc3+k0);
yc2=yc3+(k0+k1)/2;
tc=tc+h;
k0=h*ord1(tc,yc2);
k1=h*ord1(tc+h,yc2+k0);
yc1=yc2+(k0+k1)/2;
tc=tc+h;
for i=4:q/h
    yc=yc1+h*(55*ord1(tc,yc1)-59*ord1(tc-h,yc2)...
        +37*ord1(tc-2*h,yc3)-9*ord1(tc-3*h,yc4))/24;
    yc4=yc3;yc3=yc2;yc2=yc1;yc1=yc;
    tc=tc+h;
end;
t(2)=tc;y(2)=yc;uc(2)=u;
for k=3:(tf-t0)/q+1,
    for i=1:q/h,
 yc=yc1+h*(55*ord1(tc,yc1)-59*ord1(tc-h,yc2)...
     +37*ord1(tc-2*h,yc3)-9*ord1(tc-3*h,yc4))/24;
    yc4=yc3;yc3=yc2;yc2=yc1;yc1=yc;
    tc=tc+h;
    end;
    t(k)=tc;y(k)=yc;uc(k)=u;
end;
    clf;
    plot(t,y,'-r',t,uc,'-b');
    grid;
    title('raspuns sistem ordin unu');
```

//AM1 , 2 poli un zero

```
echo off;
global kp t1 t2 t3 u;
t(1)=t0;y(1,1)=y10;y(1,2)=y20;uc(1)=u;
tc=t0; yc1=[y10 y20 y30 y40];
for k=2:(tf-t0)/q+1
    for i=1:q/h
    k0=h*ord2p1z(tc,yc1);
    k1=h*ord2p1z(tc+h,yc1+k0);
    yc=yc1+(k0+k1)/2;
    yc=yc1+h*(ord2p1z(tc+h,yc)+ord2p1z(tc,yc1))/2;
    tc=tc+h;yc1=yc;
end;
t(k)=tc;y(k,1)=yc(1);y(k,2)=yc(2);uc(k)=u;
end;
clf;
subplot(211);
plot(t,y(:,1),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,2),'-r');
grid;
title('derivata raspuns sistem ordin doi');
```

//AM2 sistem de ordin 2

```
echo off;
global kp tp zeta u;
t(1)=t0;y(1,1)=y10;y(1,2)=y20;uc(1)=u;
tc=t0; yc2=[y10 y20];
yc1=yc2+h*ord2a(tc,yc2);
tc=tc+h;
for i=2:q/h
    yc=yc1+h*ord2a(tc,yc2);
    yc=yc1+h*(5*ord2a(tc+h,yc)+8*ord2a(tc,yc1)-ord2a(tc-h,yc2))/12;
    tc=tc+h;yc2=yc1;yc1=yc;
end;
t(2)=tc;y(2,1)=yc(1);y(2,2)=yc(2);uc(2)=u;
for k=3:(tf-t0)/q+1
    for i=1:q/h
    yc=yc1+h*ord2a(tc,yc2);
    yc=yc1+h*(5*ord2a(tc+h,yc)+8*ord2a(tc,yc1)-ord2a(tc-h,yc2))/12;
    tc=tc+h;yc2=yc1;yc1=yc;
end;
t(k)=tc;y(k,1)=yc(1);y(k,2)=yc(2);uc(k)=u;
end;
clf;
subplot(211);
plot(t,y(:,1),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,2),'-r');
grid;
title('derivata raspuns sistem ordin doi');
```

//AM3 , sistem de ordin 2

```
echo off;
global kp tp zeta u;
t(1)=t0;y(1,1)=y10;y(1,2)=y20;uc(1)=u;
tc=t0; yc3=[y10 y20];
yc2=yc3+h*ord2a(tc,yc3);
tc=tc+h;
yc1=yc2+h*ord2a(tc,yc2);
tc=tc+h;
for i=3:q/h
    yc=yc1+h*ord2a(tc,yc2);
    yc=yc1+h*(9*ord2a(tc+h,yc)+19*ord2a(tc,yc1)-5*ord2a(tc-h,yc2)+...
        ord2a(tc-2*h,yc3))/24;
    tc=tc+h;yc3=yc2;yc2=yc1;yc1=yc;
end;
t(2)=tc;y(2,1)=yc(1);y(2,2)=yc(2);uc(2)=u;
for k=3:(tf-t0)/q+1
    for i=1:q/h
  yc=yc1+h*ord2a(tc,yc2);
    yc=yc1+h*(9*ord2a(tc+h,yc)+19*ord2a(tc,yc1)-5*ord2a(tc-h,yc2)+...
        ord2a(tc-2*h,yc3))/24;
    tc=tc+h;yc3=yc2;yc2=yc1;yc1=yc;
```

```
end;
t(k)=tc;y(k,1)=yc(1);y(k,2)=yc(2);uc(k)=u;
end;
clf;
subplot(211);
plot(t,y(:,1),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,2),'-r');
grid;
title('derivata raspuns sistem ordin doi');
```

//PC1 , 2 poli un zero

```
echo off;
global kp t1 t2 t3 u;
t(1)=t0;y(1,1)=y10;y(1,2)=y20;uc(1)=u;
tc=t0; yc2=[y10 y20];
yc1=yc2+h*ord2p1zb(tc,yc2);
tc=tc+h;
for i=2:q/h
    yca=yc1+h*(3*ord2p1zb(tc,yc1)-ord2p1zb(tc-h,yc2))/2;
    yc=yc1+h*(ord2p1zb(tc+h,yca)+ord2p1zb(tc,yc1))/2;
    while max(abs(yc(1)-yca(1)),abs(yc(2)-yca(2)))>prec
    yca=yc;
    yc=yc1+h*(ord2p1zb(tc+h,yca)+ord2p1zb(tc,yc1))/2;
    end;
    tc=tc+h;yc2=yc1;yc1=yc;
end;
t(2)=tc;y(2,1)=yc(1);y(2,2)=yc(2);uc(2)=u;
for k=3:(tf-t0)/q+1
    for i=1:q/h
     yca=yc1+h*(3*ord2p1zb(tc,yc1)-ord2p1zb(tc-h,yc2))/2;
    yc=yc1+h*(ord2p1zb(tc+h,yca)+ord2p1zb(tc,yc1))/2;
    while max(abs(yc(1)-yca(1)),abs(yc(2)-yca(2)))>prec
    yca=yc;
    yc=yc1+h*(ord2p1zb(tc+h,yca)+ord2p1zb(tc,yc1))/2;
    end;
    tc=tc+h;yc2=yc1;yc1=yc;

end;
t(k)=tc;y(k,1)=yc(1);y(k,2)=yc(2);uc(k)=u;
end;
clf;
subplot(211);
plot(t,y(:,1),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,2),'-r');
grid;
title('derivata raspuns sistem ordin doi');
```

```
//PC2 , un 2 poli zero [ord2p1zb inlocuit cu numele
fisierului functie]

echo off;
global kp t1 t2 t3 u;
t(1)=t0;y(1,1)=y10;y(1,2)=y20;uc(1)=u;
tc=t0;yc3=[y10 y20];
k0=h*ord2p1zb(tc,yc3);
k1=h*prd2p1zb(tc+h/2,yc3+k0/2);
k2=h*ord2p1zb(tc+h,yc3+2*k1-k0);
yc2=yc3+h*(k0+4*k1+k2)/6;
tc=tc+h;
k0=h*ord2p1zb(tc,yc2)
k1=h*ord2p1zb(tc+h/2,yc2+k0/2);
k2=h*ord2p1zb(tc+h,yc2+2*k1-k0);
yc1=yc2+h*k0+4*k1+k2)/6;
tc=tc+h;
for i=3:q/h
    yca=yc1+h*(23*ord2p1zb(tc,yc1)-16*ord2p1zb(tc-h,yc2)+5*ord2p1zb(tc-
2*h,yc3)/12;
    yc=yc1+h*(5*ord2p1zb(tc+h,yca)+8*ord2p1zb(tc,yc1)-ord2p1zb(tc-
h,yc2)/12;
    while sqrt((yc(1)-yca(1))^2+(yc(2)-yca(2))^2)>prec
        yca=yc;
        yc=yc1+h*(5*ord2p1zb(tc+h,yca)+8*ord2p1zb(tc,ya)-ord2p1zb(tc-
h,yc2))/12;
    end;
    tc=tc+h;yc3=yc2;yc2=yca;yc1=yc;
end;
t(2)=tc;y(2,1)=yc(1);y(2,2)=yc(2);uc(2)=u;
for k=3:(tf-t0)/q+1;
    for i=1:q/h;
        yca=yc1+h*(23*ord2p1zb(tc,yc1)-16*ord2p1zb(tc-
h,yc2)+5*ord2p1zb(tc-2*h,yc3))12;
        yc=yc1+h*(5*ord2p1zb(tc+h,yca)+8*ord2p1zb(tc,yc1)-ord2p1zb(tc-
h,yc2))/12;
        while sqrt((yc(1)-yca(1))^2+(yc(2)-yca(2))^2)>prec
            yca=yc;
            yc=yc1+h*(5*ord2p1zb(tc+h,yca)+8*ord2p1zb(tc,yc1)-
ord2p1zb(tc-h,yc2))/12;
        end;
        tc=tc+h;yc3=yc2;yc2=yc1;yc1=yc;
    end;
    t(k)=tc;y(k,1)=yc(1);y(k,2)=yc2;uc(k)=u;
end;
clf;
subplot(211);
plot(t,y(:,1),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,2),'-r');
grid;
title('raspuns sistem ordin doi');
```

//PC3 ordin 1

```
echo off;
global kp tp u;
t(1)=t0;y(1)=y0;uc(1)=u;
tc=t0; yc4=y0;
k0=h*ord1(tc,yc4);
k1=h*ord1(tc+h/2,yc4+k0/2);
k2=h*ord1(tc+h,yc4+2*k1-k0);
yc3=yc4+h*(k0+4*k1+k2)/6;
tc=tc+h;
k0=h*ord1(tc,yc3);
k1=h*ord1(tc+h/2,yc3+k0/2);
k2=h*ord1(tc+h,yc3+2*k1-k0);
yc2=yc3+h*(k0+4*k1+k2)/6;
tc=tc+h;
k0=h*ord1(tc,yc2);
k1=h*ord1(tc+h/2,yc2+k0/2);
k2=h*ord1(tc+h,yc2+2*k1-k0);
yc1=yc2+h*(k0+4*k1+k2)/6;
tc=tc+h;
for i=4:q/h
    yca=yc1+h*(55*ord1(tc,yc1)-59*ord1(tc-h,yc2)+37*ord1(tc-2*h,yc3)...
        -9*ord1(tc-3*h,yc4))/24;
    yc=yc1+h*(9*ord1(tc+h,yca)+19*ord1(tc,yc1)-5*ord1(tc-h,yc2)...
        +ord1(tc-2*h,yc3))/24;
    while abs(yc-yca)>prec
    yca=yc;
    yc=yc1+h*(9*ord1(tc+h,yca)+19*ord1(tc,yc1)...
        -5*ord1(tc-h,yc2)+ord1(tc-2*h,yc3))/24;
    end;
    tc=tc+h;yc4=yc3;yc3=yc2;yc2=yc1;yc1=yc;
end;
t(2)=tc;y(2)=yc;uc(2)=u;
for k=3:(tf-t0)/q+1
    for i=1:q/h
    yca=yc1+h*(55*ord1(tc,yc1)-59*ord1(tc-h,yc2)+37*ord1(tc-2*h,yc3)...
        -9*ord1(tc-3*h,yc4))/24;
    yc=yc1+h*(9*ord1(tc+h,yca)+19*ord1(tc,yc1)-5*ord1(tc-h,yc2)...
        +ord1(tc-2*h,yc3))/24;
    while abs(yc-yca)>prec
    yca=yc;
    yc=yc1+h*(9*ord1(tc+h,yca)+19*ord1(tc,yc1)-5*ord1(tc-h,yc2)...
        +ord1(tc-2*h,yc3))/24;
    end;
    tc=tc+h;yc4=yc3;yc3=yc2;yc2=yc1;yc1=yc;
end;
t(k)=tc;y(k)=yc;uc(k)=u;
end;
clf;
plot(t,y,'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin unu');

Ex1.b.
```

//ode23 ordin 1 sin

```
echo off;
global kp tp a w;  //pui ce variabile ai in fisierul functie
kp=2;tp=1;a=1;w=1;t0=0;tf=20;y0=0;
[t,y]=ode23('ord1sin',[t0 tf],y0);
for i=1:length(t);
    uc(i)=a*sin(w*t(i));
end;
clf;
plot(t,y,'-r',t,uc,'-b');
grid;
title('raspuns sistem ordin unu');
```

//ode23 ordin 2

```
echo off;
global kp t1 t2 t3 u;
kp=2;t1=10;t2=1;t3=2;u=1;t0=0;tf=40;y10=0;y20=0;
[t,y]=ode23('ord2p1zb',[t0 tf],[y10 y20]);
for i=1:length(t);
    uc(i)=u;
end;
clf;
subplot(211);
plot(t,y(:,2),'-r',t,uc,'-g');
grid;
title('raspuns sistem ordin doi');
subplot(212);
plot(t,y(:,1),'-r');
grid;
title('derivata raspuns sistem ordin doi');

Ex2 //sisteme – apel newtraph
```

```
function [sol,iter]=newtraph(F,dF,x0,prec)
  n=length(x0);
  dx=2*prec*ones(n,1);
  x_c=x0;
  iter=0;
  while (norm(dx)>prec),
    J=feval(nume_dF,x_c);
    dx=-inv(J)*feval(F,x_c);
    x_c=x_c+dx;
    iter=iter+1;
  end;
  sol=x_c;


[xstar,iter]=newtraph('F','dF',[-1,3,-2])


//gradient [minim / maxim al unei functii]
function [x,nr_it]=opt_grad(x0,epsilon)
nr_it=1;x_curent=x0;itermax=1500;
```

```
h=0.001;
p=0.001;
for k=1:n,
v=zeros(1,n);v(k)=1;
grad_curent(k)=(f1(x0+h/2*v)-f1(x0-h/2*v))/h;
end;
while (norm(grad_curent)>=epsilon)&(nr_it<=itermax)
%pentru o funcţie de maximizat „–" se înlocuieşte cu „+"
x_viitor=x_curent-p*grad_curent/norm(grad_curent);
for k=1:n,
v=zeros(1,n);v(k)=1;
grad_viitor(k)=(f1(x_viitor+h/2*v)-f1(x_viitor-h/2*v))/h;
end;
x_curent=x_viitor;
grad_curent=grad_viitor;
nr_it=nr_it+1;
end;
x=x_curent;

function y=f1(x)
y=5*x^2+2*x+13;
```

//apel_opt_grad

```
[x,nr_it]=opt_grad(0,1e-3)
```

```
//ex3 subpunct c) matrice monica m > n
echo off;
[m,n]=size(a);

a1=a;

q=eye(m);

for k=1:n

    sig=0;

    for i=k:m

        sig=sig+a(i,k)^2;

    end

    sig=sign(a(k,k))*sqrt(sig);

    for i=1:m

        if i<=k-1

            v(i)=0;

        elseif i==k
```

```
                    v(i)=sig+a(k,k);

            else v(i)=a(i,k);

            end

        end

    beta=sig*(sig+a(k,k));

    q1=eye(m)-(v'*v)/beta;

    q=q*q1;

    a=q1*a;

end
```

//ex3 subpunct c) matrice patratica n x n

```
echo off;
[m,n]=size(a);

q=eye(m);

p=eye(n);

a1=a;

k=1;

prec=1e-4;

ind=1;

for j=1:n

    norm(j)=0;

    for i=1:m

        norm(j)=norm(j)+a(i,j)^2;

    end

end

while ind ==1 & k<=n

    l=k;

    for j=k+1:n

        if norm(j)>norm(l)

            l=j;

        end
```

```
end
if norm(l)==0

    ind=0;
else if l~=k

        p1=eye(n);p1(k,k)=0;p1(l,l)=0;p1(l,k)=1;p1(k,l)=1;

        a=a*p1;

        p=p1*p;

    end

    sig=0;

    for i=k:m

        sig=sig+a(i,k)^2;

    end

    sig=sign(a(k,k))*sqrt(sig);

    for i=1:m

        if i<=k-1

            v(i)=0;

        elseif i==k

                v(i)=sig+a(k,k);

            else v(i)=a(i,k);

        end

    end

    beta=sig*(sig+a(k,k));

    q1=eye(m)-(v'*v)/beta;

    a=q1*a;

    q=q1*q;

    for j=k+1:n

        norm(j)=0;

        for i=k+1:m

            norm(j)=norm(j)+a(i,j)^2;
```

```
            end
        end
        k=k+1;
    end
end
r=0;
for i=1:min(m,n)
    if r<=min(m,n)
        if abs(a(i,i))>prec
            r=r+1;
        end
    end
end
a=a';
q2=eye(n);
p2=eye(r);
for k=1:r
        sig=0;
        for i=k:n
            sig=sig+a(i,k)^2;
        end
        sig=sign(a(k,k))*sqrt(sig);
        for i=1:n
            if i<=k-1
                v(i)=0;
            elseif i==k
                    v(i)=sig+a(k,k);
                else v(i)=a(i,k);
            end
```

```
        end
        beta=sig*(sig+a(k,k));
        q1=eye(n)-(v'*v)/beta;
        a=q1*a;
        q2=q2*q1;
end
Z=p*q2;
aint=a;
for k=r:-1:1
    a(k,k)=1/a(k,k);
    for i=k-1:-1:1
        s=0;
        for j=i+1:r
            s=s+a(i,j)*a(j,k);
        end
        a(i,k)=-s/a(i,i);
    end
end
psa=Z*a*q;
```