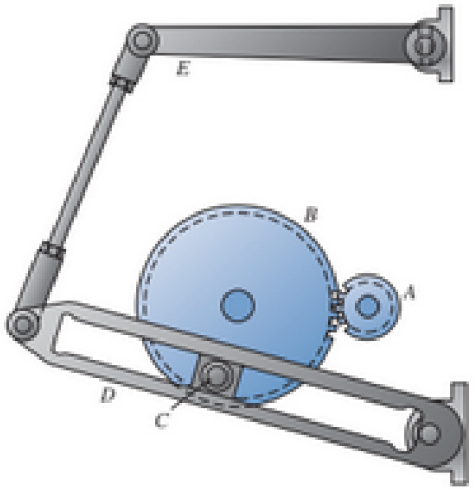
CINEMATICA MECANISMO:




```
clc
clear
close all

% Definir las constantes y variables del problema
dt = 0.01;                   % Paso de tiempo en segundos
t_max = 10;                 % Tiempo máximo de la simulación en segundos
t = 0:dt:t_max;              %Vector Tiempo

%Radios
rb=0.3;
ra=0.1;
rbc=rb;
rod=1.3;
rde=1.1;
rpe=1;
d=0.6;
h=0.16;
d2 = 0;
h2 =1.33;

%Angulos Iniciales Theta4 y Theta5
theta40 = pi/2;
theta50 = 2.617;

% Crear vectores para almacenar los datos de la simulación
%Longitudes
Rocx=zeros(1,t_max/dt+1);
Rocy=zeros(1,t_max/dt+1);
Roc=zeros(1,t_max/dt+1);

%Aceleraciones
Acx=zeros(1,t_max/dt+1);
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```
Acy=zeros(1,t_max/dt+1);
Ac=zeros(1,t_max/dt+1);
Acox=zeros(1,t_max/dt+1);
Acoy=zeros(1,t_max/dt+1);
Ac_ox=zeros(1,t_max/dt+1);
Ac_oy=zeros(1,t_max/dt+1);
%Velocidades
Vcx=zeros(1,t_max/dt+1);
Vcy=zeros(1,t_max/dt+1);
Vc=zeros(1,t_max/dt+1);
Vcox=zeros(1,t_max/dt+1);
Vcoy=zeros(1,t_max/dt+1);
Vc_ox=zeros(1,t_max/dt+1);
Vc_oy=zeros(1,t_max/dt+1);

%BARRAS
%Engranaje A
Wa=zeros(1,t_max/dt+1);
alphaa=zeros(1,t_max/dt+1);
theta1=zeros(1,t_max/dt+1);
%Engranaje B
Wb=zeros(1,t_max/dt+1);
alphab=zeros(1,t_max/dt+1);
theta2=zeros(1,t_max/dt+1);

%Barra OD
alphaoc=zeros(1,t_max/dt+1);
alphaod=zeros(1,t_max/dt+1);
Woc=zeros(1,t_max/dt+1);
Wod=zeros(1,t_max/dt+1);
theta3 = zeros(1, t_max/dt+1);

%Barra DE
alphade=zeros(1,t_max/dt+1);
Wde=zeros(1,t_max/dt+1);
theta4 = zeros(1, t_max/dt+1);

%Barra PE
alphape=zeros(1, t_max/dt+1);
Wpe=zeros(1, t_max/dt+1);
theta5 = zeros(1, t_max/dt+1);


% Definir las condiciones iniciales

Wa(1)=2;
alphaa(1)=1;
theta1(1)=0;
```

```
% Realizar la simulación
for i=1:length(t)-1
    %_____________________________________________________________________
    %DATOS ENGRANAJE A:
    alphaa(i)=alphaa(1)+((i*dt).^2);
    Wa(i)=Wa(1)+alphaa(1)*(i*dt)+(((i*dt).^3)/3);
    theta1(i)=theta1(1)+Wa(1)*(i*dt)+(1/2)*(alphaa(1))*((i*dt).^2)+(1/12)*((i*dt).^4);
    %_____________________________________________________________________
    %DATOS ENGRANAJE B:
    alphab(i)=(alphaa(1)+((i*dt).^2))*(-ra/rb);
    Wb(i)=(Wa(1)+alphaa(1)*(i*dt)+(((i*dt).^3)/3))*(-ra/rb);
    theta2(i)=(Woc(1)*(i*dt)+(1/2)*alphab(1)*((i*dt).^2)+(1/12*((i*dt).^4)))*(ra/rb);
    %_____________________________________________________________________
    %DATOS BARRA O-D
    Rocx(i)=-d+rb*cos(theta2(i));
    Rocy(i)=h+rb*sin(theta2(i));
    Roc=[Rocx Rocy];
    %Aceleracion Angular
    Acx(i)=-alphab(i)*rb*sin(theta2(i))-(Wb(i).^2)*rb*cos(theta2(i));
    Acy(i)=alphab(i)*rb*cos(theta2(i))+(Wb(i).^2)*rb*sin(theta2(i));
    Ac=[Acx Acy];
    Acox(i)=((dot(Ac,Roc))/(dot(Ac,Ac)))*Acx(i);
    Acoy(i)=((dot(Ac,Roc))/(dot(Ac,Ac)))*Acy(i);
    Ac_ox(i)=Acx(i)-Acox(i);
    Ac_oy(i)=Acy(i)-Acoy(i);
    alphaoc(i)=(abs([Ac_ox Ac_oy]))/(abs(Roc));
    alphaod(i)=alphaoc(i);
    %Velocidad Angular
    Vcx(i)= -Wb(i)*rb*sin(theta2(i));
    Vcy(i)=Wb(i)*rb*cos(theta2(i));
    Vc=[Vcx Vcy];
    Vcox(i)=((dot(Vc,Roc))/(dot(Vc,Vc)))*Vcx(i);
    Vcoy(i)=((dot(Vc,Roc))/(dot(Vc,Vc)))*Vcy(i);
    Vc_ox(i)=Vcx(i)-Vcox(i);
    Vc_oy(i)=Vcy(i)-Vcoy(i);
    Woc(i)=(abs([Vc_ox Vc_oy]))/(abs(Roc));
    Wod(i)=Woc(i);
    %Angulo
    theta3(i+1) =-atan((h+rb*sin(theta2(i)))/(-d+rb*cos(theta2(i))));
    %_____________________________________________________________________
    %DATOS BARRA D-E y DATOS BARRA P-E
    %Angulos
    [theta4(i),theta5(i)] = newtonrhaptheta(rod,rde,rpe,d2,h2,theta3(i),theta40,theta50);
    theta40 = theta4(i);
    theta50 = theta5(i);
    %Velocidad Angular
    A1=[-sin(theta5(i))  -rde*sin(theta4(i)); -cos(theta5(i)) rde*cos(theta4(i))];
    B1=[-Wod(i)*rod*sin(theta3(i)); -Wod(i)*rod*cos(theta3(i))];
    X1=A1\B1;
    Wpe(i)=X1(1);
```

```
    Wde(i)=X1(2);
    %Aceleracion Angular
    A2=[rpe*sin(theta5(i)) rde*sin(theta4(i));rpe*cos(theta5(i)) -rde*cos(theta4(i))];
    B2=[-(Wpe(i).^2)*rpe*cos(theta5(i))+alphaod(i)*rod*sin(theta3(i))+(Wod(i).^2)*rod*cos(theta
    X2=A2\B2;
    alphape(i)=X2(1);
    alphade(i)=X2(2);
end
```

CINETICA MECANISMO:

```
gamma=zeros(1,t_max/dt+1);
phi=zeros(1,t_max/dt+1);

for i=1:length(t)-1
    gamma(i)=(pi/2)-theta3(i);
    phi(i)= theta2(i)-gamma(i);
end
```

SISTEMA DE ECUACIONES 12x12:

$$F_{BH} + F_C\cos\gamma = m_{BC}(= -\alpha_B r_{BG}\sin\theta_2 + \omega_B^2\, r_{BG}\cos\theta_2) \quad (1)$$

$$-F_{BV} + F_C\sin\gamma - m_{BC}g = m_{BC}(\alpha_B r_{BG}\cos\theta_2 + \omega_B^2\, r_{BG}\sin\theta_2) \quad (2)$$

$$-r_{BG}\sin\theta_2(F_{BH} + F_C\cos\gamma) - r_{BG}\cos\theta_2(F_{BV} + F_C\sin\gamma) - \tau_B = -\frac{1}{2}m_{BC}r_{BC}^2\alpha_B \quad (3)$$

$$F_{DH} - F_{OH} - F_C\cos\gamma = m_{OD}(+\alpha_{OD}r_{OG}\sin\theta_3 + \omega_{OD}^2\, r_{OG}\cos\theta_3) \quad (4)$$

$$F_{OV} - F_{DV} - F_C\sin\gamma - m_{OD}g = m_{OD}(\alpha_{OD}r_{OG}\cos\theta_3 - \omega_{OD}^2\, r_{OG}\sin\theta_3) \quad (5)$$

$$-r_{OG}\sin\theta_3(F_{DH} + F_{OH}) + r_{OG}\cos\theta_3(F_{DV} + F_{OV}) + (r_{OC} - r_{OG})F_C = -\frac{1}{12}m_{OD}r_{OD}^2\alpha_{OD} \quad (6)$$

$$F_{PH} - F_{EH} - F_{carga} = m_{PE}(\omega_{PE}^2\, r_{PG}\cos\theta_5 + \alpha_{PE}r_{PG}\sin\theta_5) \quad (7)$$

$$F_{EV} - F_{PV} - m_{PE}g = m_{PE}(-\omega_{PE}^2\, r_{PG}\sin\theta_5 + \alpha_{PE}r_{PG}\cos\theta_5) \quad (8)$$

$$r_{PG}sin\theta_5(F_{EH}+F_{PH}+F_{carga})-r_{PG}cos\theta_5(F_{EV}+F_{PV})=-\frac{1}{12}m_{PE}r_{PE}^2\alpha_{PE} \quad (9)$$

$$F_{EH}+F_{carga}-F_{DH}=$$

$$m_{DE}(\alpha_{OD}r_{OD}\sin\theta_3+\omega_{OD}^2\,r_{OD}\cos\theta_3-\alpha_{DE}r_{DEG}\sin\theta_4-\omega_{DE}^2\,r_{DEG}\cos\theta_4) \quad (10)$$

$$F_{DV}-F_{EV}-m_{PE}g=$$

$$m_{DE}(\alpha_{OD}r_{OD}\cos\theta_3-\omega_{OD}^2 r_{OD}\sin\theta_3+\alpha_{DE}r_{DEG}\cos\theta_4-\omega_{DE}^2\,r_{DEG}\sin\theta_4) \quad (11)$$

$$-r_{DEG}sin\theta_4(F_{EH}+F_{DH}+F_{carga})-r_{DEG}cos\theta_4(F_{EV}+F_{DV})=\frac{1}{12}m_{DE}r_{DE}^2\alpha_{DE} \quad (12)$$

F_{BH}, F_{BV}, F_{OH}, F_{OV}, F_{DH}, F_{DV}, F_{PH}, F_{PV}, F_{EH}, F_{EV}, F_{carga}, F_C

```
%Solucion Ecuaciones

%Definir los valores necesarios
%Radios(Centro de Gravedad)
rbg=0.2;
rog=0.6;
rpg=0.5;
rdeg=0.6;
%Masas
mbc=0.5;
mod=0.4;
mpe=0.45;
mde=0.7;
%Constantes
g=9.78;
Tb=0.5;

%Definir Vectores de Fuerza
Fbh=zeros(1,t_max/dt+1);
Fbv=zeros(1,t_max/dt+1);
Foh=zeros(1,t_max/dt+1);
Fov=zeros(1,t_max/dt+1);
Fdh=zeros(1,t_max/dt+1);
Fdv=zeros(1,t_max/dt+1);
Fph=zeros(1,t_max/dt+1);
Fpv=zeros(1,t_max/dt+1);
Feh=zeros(1,t_max/dt+1);
Fev=zeros(1,t_max/dt+1);
Fcarga=zeros(1,t_max/dt+1);
```

```
Fc=zeros(1,t_max/dt+1);

for i=1:length(t)-1
    A3=[1 0 0 0 0 0 0 0 0 0 0 cos(gamma(i));
        0 -1 0 0 0 0 0 0 0 0 0 sin(gamma(i));
        -rbg*sin(theta2(i)) -rbg*cos(theta2(i)) 0 0 0 0 0 0 0 0 -rbg*sin(theta2(i))*cos(gamma
        0 0 -1 0 1 0 0 0 0 0 0 -cos(gamma(i));
        0 0 0 1 0 -1 0 0 0 0 0 -sin(gamma(i));
        0 0 -rog*sin(theta3(i)) rog*cos(theta3(i)) -rog*sin(theta3(i)) rog*cos(theta3(i)) 0 0 0
        0 0 0 0 0 0 1 0 -1 0 -1 0;
        0 0 0 0 0 0 0 -1 0 1 0 0;
        0 0 0 0 0 0 rpg*sin(theta5(i)) -rpg*cos(theta5(i)) rpg*sin(theta5(i)) -rpg*cos(theta5(i
        0 0 0 0 -1 0 0 0 1 0 1 0;
        0 0 0 0 0 1 0 0 0 -1 0 0;
        0 0 0 0  -rdeg*sin(theta4(i)) -rdeg*cos(theta4(i)) 0 0 -rdeg*sin(theta4(i)) -rdeg*cos(t

    B3=[mbc*(-alphab(i)*rbg*sin(theta2(i))+(Wb(i).^2)*rbg*cos(theta2(i)));
        mbc*(alphab(i)*rbg*cos(theta2(i))+(Wb(i).^2)*rbg*sin(theta2(i)))+mbc*g;
        (-1/2)*mbc*(rbc.^2)*alphab(i)+Tb;
        mod*(alphaod(i)*rog*sin(theta3(i))+(Wod(i).^2)*rog*cos(theta3(i)));
        mod*(alphaod(i)*rog*cos(theta3(i))-(Wod(i).^2)*rog*sin(theta3(i)))+mod*g;
        (-1/12)*mod*(rod.^2)*alphaod(i);
        mpe*((Wpe(i).^2)*rpg*cos(theta5(i))+alphape(i)*rpg*sin(theta5(i)));
        mpe*(-(Wpe(i).^2)*rpg*sin(theta5(i))+alphape(i)*rpg*cos(theta5(i)))+mpe*g;
        (-1/12)*mpe*(rpe.^2)*alphape(i);
        mde*(alphaod(i)*rod*sin(theta3(i))+(Wod(i).^2)*rod*cos(theta3(i))-alphade(i)*rdeg*sin(t
        mde*(alphaod(i)*rod*cos(theta3(i))-(Wod(i).^2)*rod*sin(theta3(i))+alphade(i)*rdeg*cos(t
        (1/12)*mde*(rde.^2)*alphade(i)];

    X3=A3\B3;

    Fbh(i)=X3(1);
    Fbv(i)=X3(2);
    Foh(i)=X3(3);
    Fov(i)=X3(4);
    Fdh(i)=X3(5);
    Fdv(i)=X3(6);
    Fph(i)=X3(7);
    Fpv(i)=X3(8);
    Feh(i)=X3(9);
    Fev(i)=X3(10);
    Fcarga(i)=X3(11);
    Fc(i)=X3(12);
end
```

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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  8.766744e-18.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.253881e-17.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.076634e-17.
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Warning: Matrix is singular to working precision.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.620931e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.353262e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  5.590395e-19.
Warning: Matrix is singular to working precision.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.129966e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  9.485688e-18.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.283955e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.437946e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  3.438023e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  6.380079e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.982004e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  7.711665e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.430535e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.976960e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  3.568689e-18.
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Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.534076e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  8.883983e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  5.263112e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.687074e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.762321e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.059748e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  5.379121e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  7.660167e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.743401e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.758056e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.560824e-17.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.198461e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.783478e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  8.450354e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.173287e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.106685e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.525581e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  3.095918e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.069034e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.329772e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  5.122011e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  9.924926e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.807532e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.987199e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.727964e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  3.167155e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.085817e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  7.058191e-19.
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Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.824235e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.100387e-18.
Warning: Matrix is singular to working precision.
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Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.041585e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.334985e-17.
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Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.937350e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  3.955665e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.900043e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.264643e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  2.675266e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.423879e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.093774e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.930888e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.391396e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.549896e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.361347e-17.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.521545e-17.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.455812e-19.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.466528e-19.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.311825e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  1.633373e-18.
Warning: Matrix is singular to working precision.
Warning: Matrix is singular to working precision.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  8.575283e-18.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  5.095499e-20.
Warning: Matrix is close to singular or badly scaled. Results may be inaccurate. RCOND =  4.918819e-19.
Warning: Matrix is singular to working precision.
```