Contents

- Problem 5
- Problem 6
- Problem 7

Problem 5

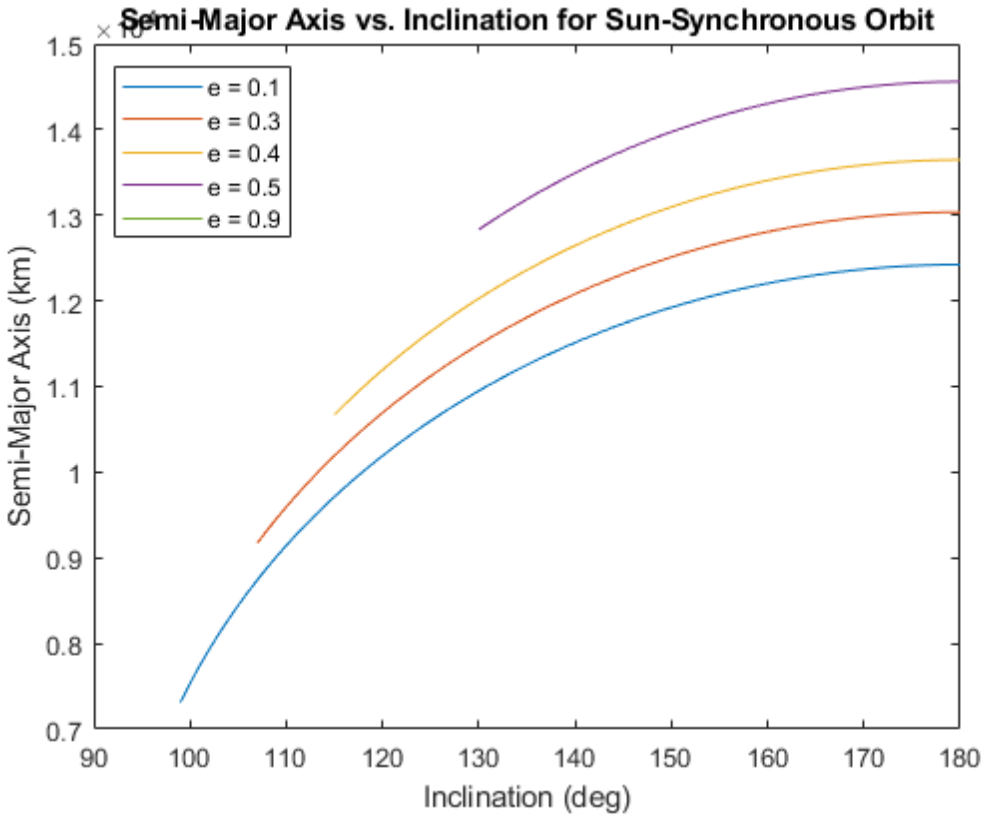
```
clear all
clc

a = 8433;
e = .1179;
i = deg2rad(19);
raan = deg2rad(310);
argp = deg2rad(111);
ta = 0;
mu = 398600.4415;
[r,v] = oe2rv(mu,a,e,i,raan,ta,argp);
rmag = norm(r);
vmag = norm(v);
h = cross(r,v);
hmag = norm(h);     %setup
p = (hmag^2)/mu;
rp = p/(1+e);
raold = p/(1-e);
ranew = raold+300;

% deltav = vwant - vhave
% The spacecraft is at periapsis, and we want a biggere apoapsis. We will
% do the maneuver here. The maneuver will be parallel to the velocity and
% perpendicular to the position.
awant = (ranew+rp)/2;
vhave = vmag;
vwant = sqrt(mu*((2/rp)-(1/awant)));
deltav = abs(vhave - vwant)

dvr = [0 0 0]'
dvtan = deltav.*(cross(h,r)/(norm(cross(h,r))))
```

```
If given angle related to singularities, put in input 7 (argp).

deltav =

    0.0532


dvr =

     0
     0
     0


dvtan =

   -0.0457
```

```
    0.0265
   -0.0062
```

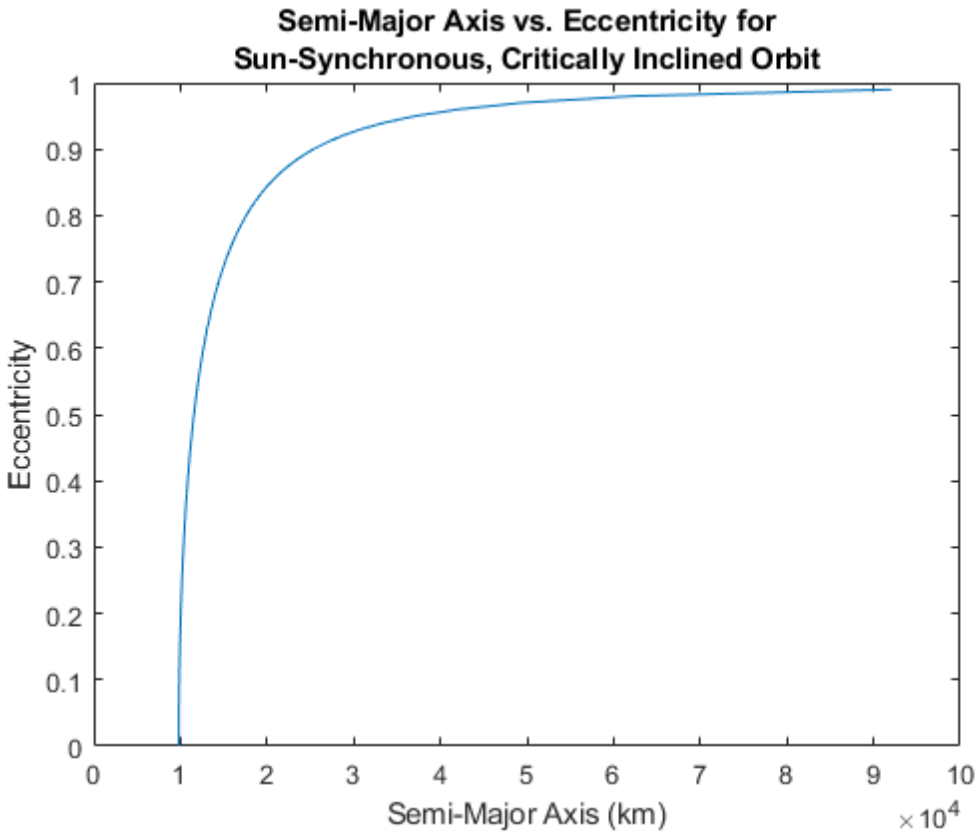
Problem 6

```
clear all
clc

mu = 398600.4415;
re = 6378.1363;
nr = 1.991e-7;
j2 = 0.00108248;

e = [0.1 0.3 0.4 0.5 0.9]';

sma = @(i,e) (( -3*sqrt(mu)*j2*(re^2).*cos(i) )./(2*nr*(1-e.^2).^2) ).^(2/7);

i = deg2rad(95:1:180);

a = sma(i, e);
p = a.*(1-e.^2);
rp = p./(1+e);

for j = 1:length(a)
    for k = 1:length(a(:,1))
        if rp(k,j) < re
            a(k,j) = NaN;
        end
    end
end

fig = 1;
figure(fig)
plot(rad2deg(i),a(1,:))
hold on
plot(rad2deg(i),a(2,:))
plot(rad2deg(i),a(3,:))
plot(rad2deg(i),a(4,:))
plot(rad2deg(i),a(5,:))
xlabel('Inclination (deg)')
ylabel('Semi-Major Axis (km)')
legend({'e = 0.1','e = 0.3','e = 0.4','e = 0.5','e = 0.9'},'Location','northwest')
title('Semi-Major Axis vs. Inclination for Sun-Synchronous Orbit')
```



Problem 7

```
clear all
clc

mu = 398600.4415;
re = 6378.1363;
nr = 1.991e-7;
j2 = 0.00108248;
% Critically inclined angle is found when apsidal regression = 0
i = deg2rad(116.5650512); % Critically inclined, must change e and a to make sun-synchronous.

e = 0:0.01:0.99;
sma = @(i,e) (( -3*sqrt(mu)*j2*(re^2).*cos(i) )./(2*nr*(1-e.^2).^2) ).^(2/7);
a = sma(i,e);

fig = 2;
figure(fig)
plot(a,e)
xlabel('Semi-Major Axis (km)')
ylabel('Eccentricity')

title({'Semi-Major Axis vs. Eccentricity for';'Sun-Synchronous, Critically Inclined Orbit'})
```



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