Homework 2

Problem 2.9

${}^{A}_{B}T = {}^{A}_{C}T\ {}^{C}_{B}T$ (represented by T3, T1, T2, respectively)

Other formulas are shown in MATLAB code.

Calculations shown in MATLAB code:

Transformation matrix function:

```
function T = transformationMatrix(theta,m,P)
%transformation matrix rotating in a degree of theta with axis m, and with a tranlation of P
v = 1 - cos(theta/180*pi);
s = sin(theta/180*pi);
c = cos(theta/180*pi);

T = [m(1)^2*v+c, m(1)*m(2)*v-m(3)*s, m(1)*m(3)*v+m(2)*s, P(1);
     m(1)*m(2)*v+m(3)*s, m(2)^2*v+c, m(2)*m(3)*v-m(1)*s, P(2);
     m(1)*m(3)*v-m(2)*s, m(2)*m(3)*v+m(1)*s, m(3)^2*v+c, P(3);
     0, 0, 0, 1];
end
```

Rotation matrix function (from transformation matrix):

```
function R = rotationMatrix(T)
%Rotation matrix derived from tranformation matrix
R = T(1:3,1:3);
end
```

Rotation axis and angle function:

```
function [theta,m] = rotationAxisAngle(R)
%find the axis and the angle of the rotation from the rotation matrix
%(theta in radians)
theta = acos((R(1,1)+R(2,2)+R(3,3)-1)/2);
m = [(R(3,2)-R(2,3))/2/sin(theta),(R(1,3)-R(3,1))/2/sin(theta),(R(2,1)-R(1,2))/2/sin(theta)]';
end
```

MATLAB script to compute rotation axis and angle:

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```
clc; clear; %clear workspace and command window
%% problem 2.9
%Transformation from C to A, 35 degree about X axis
T1 = transformationMatrix(35,[1,0,0],[0,0,0]);

%Transformation from B to C, 120 degree about Y axis
T2 = transformationMatrix(120,[0,1,0],[0,0,0]);

%Transformation from B to A
T3 = T1*T2;

%Rotation from B to A
R = rotationMatrix(T3);

%Rotation angle and axis
[theta, m] = rotationAxisAngle(R);

%Rotation axis

disp("The rotation axis is:")
disp(m)
disp("The rotation angle in degree is:")
disp(theta*180/pi)
```

Output:

```
The rotation axis is:
    0.1711
    0.9397
    0.2963

The rotation angle in degree is:
  123.0392
```

Problem 2.10 and 2.11 are not required, because my choice of programming tool is MATLAB.

Problem 3.4

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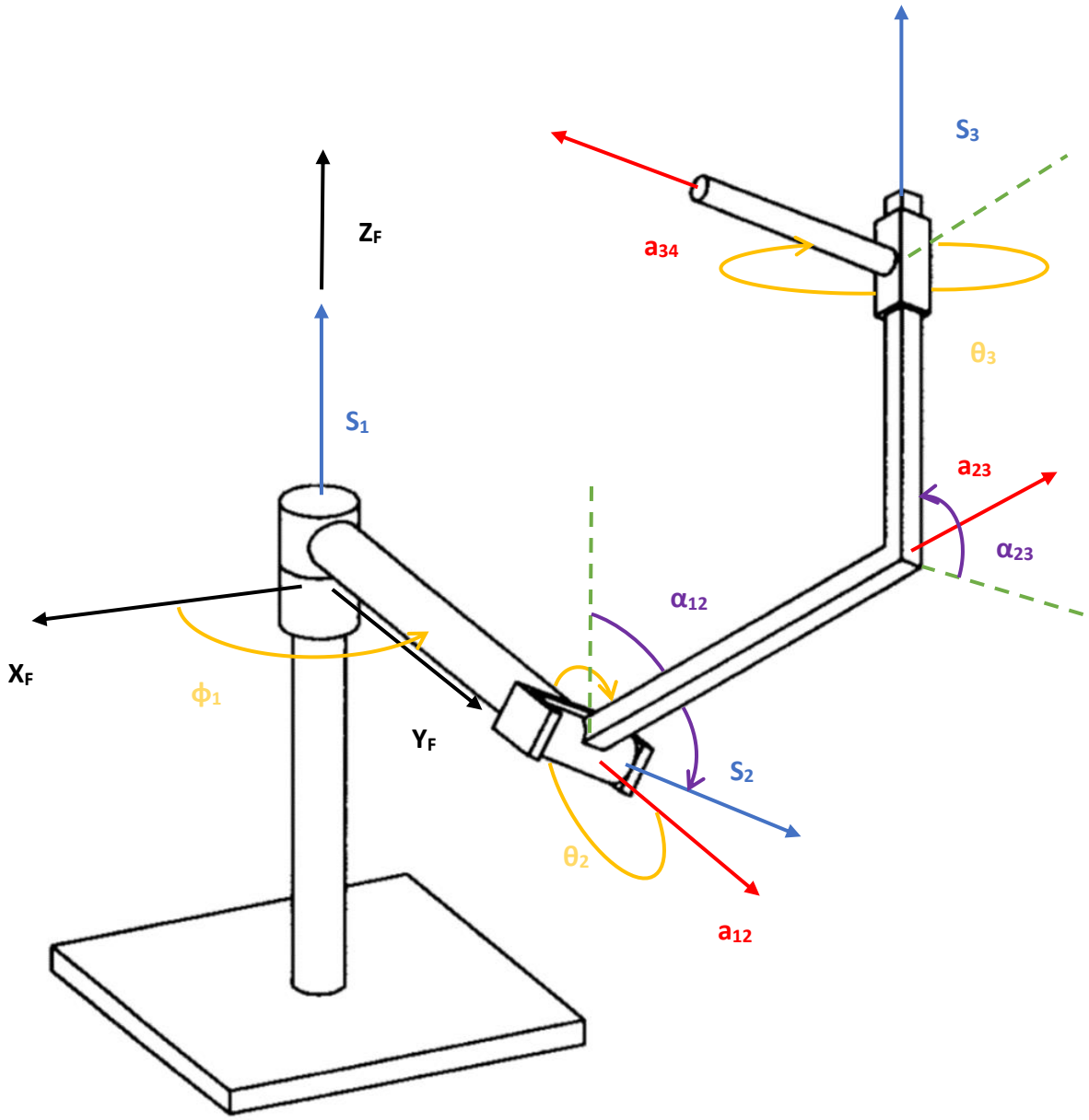

Variable parameters: ϕ_1, θ_2, S_3