Answer Sheet

Index No: 210503H

1. Homogeneous transformation matrix H_1^0 for 3.4.

```
H_1_in_0 :
     0    -1     0     2
     1     0     0     3
     0     0     1     1
     0     0     0     1
```

2. MATLAB code for 3.1 ~ 3.6.

```
% frame {0}
figure;
trplot(eye(4), 'frame', '0', 'color', 'b', 'axis', [0 4 0 4 0 3]);
grid on;
xlabel('X'); ylabel('Y'); zlabel('Z');
title('3D Coordinate Frame {0}');
hold on;

% 3.2
R_1_in_0 = rotz(90, "deg");
t_1_in_0 = [2; 3; 1];
disp("Rotation Matrix: ");
disp(R_1_in_0);
disp("Translation matrix: ");
disp(t_1_in_0);
```

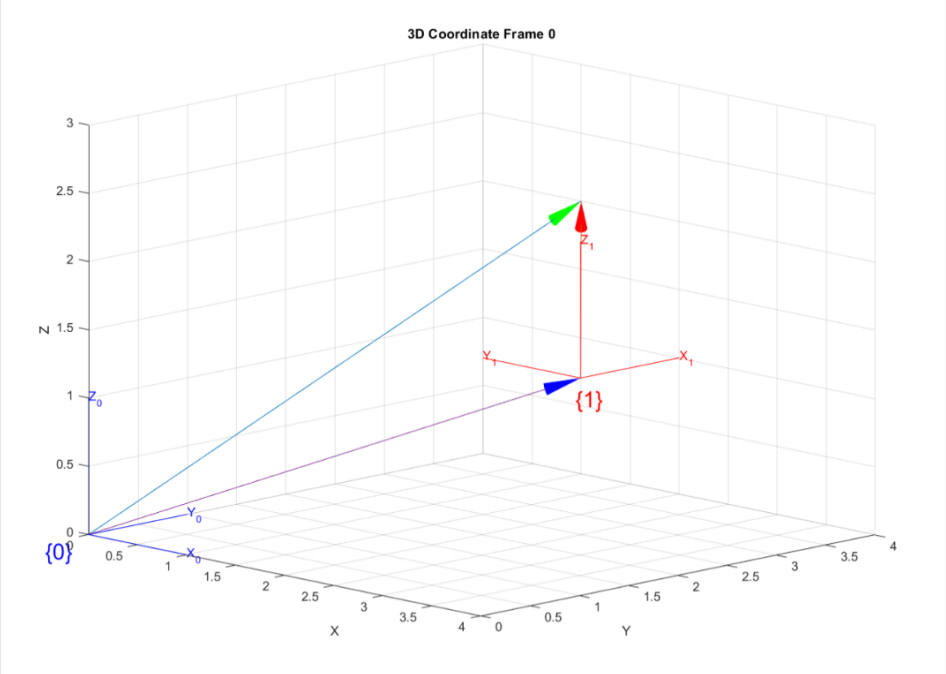
```
% 3.3
plot_arrow([0 0 0]', t_1_in_0,'b');

% 3.4
H_1_in_0 = rt2tr(R_1_in_0,t_1_in_0);
trplot(H_1_in_0, 'frame', '1', 'color', 'r');
disp('H_1_in_0 :');
disp(H_1_in_0);

% 3.5
p_in_1 = [1; 1; 1];
p_in_0 = (R_1_in_0) * p_in_1 + (t_1_in_0);
disp(p_in_0);
plot_arrow([0 0 0]', p_in_0 , 'g');

% 3.6
plot_arrow(t_1_in_0,p_in_0,'r');
```

3. Final output MATLAB figure for the operations in 3.1 ~ 3.6.



4. Homogeneous transformation matrix H_0^1 for 3.8.

```
H_0_in_1 :
     0     1     0    -3
    -1     0     0     2
     0     0     1    -1
     0     0     0     1
```

5. t_0^1 for 3.10.

```
t_0_in_1 :
    -3
     2
    -1
```

6. MATLAB code for 3.7 ~ 3.11.

```
% 3.7:frame {1}
figure;
T = eye(4);
trplot(T, 'frame', '1', 'color', 'r', 'axis', [-4 2 -1 3 -2 2]);
grid on;
xlabel('X');
ylabel('Y');
zlabel('Z');
title('3D Coordinate Frame {1}');
hold on;
```

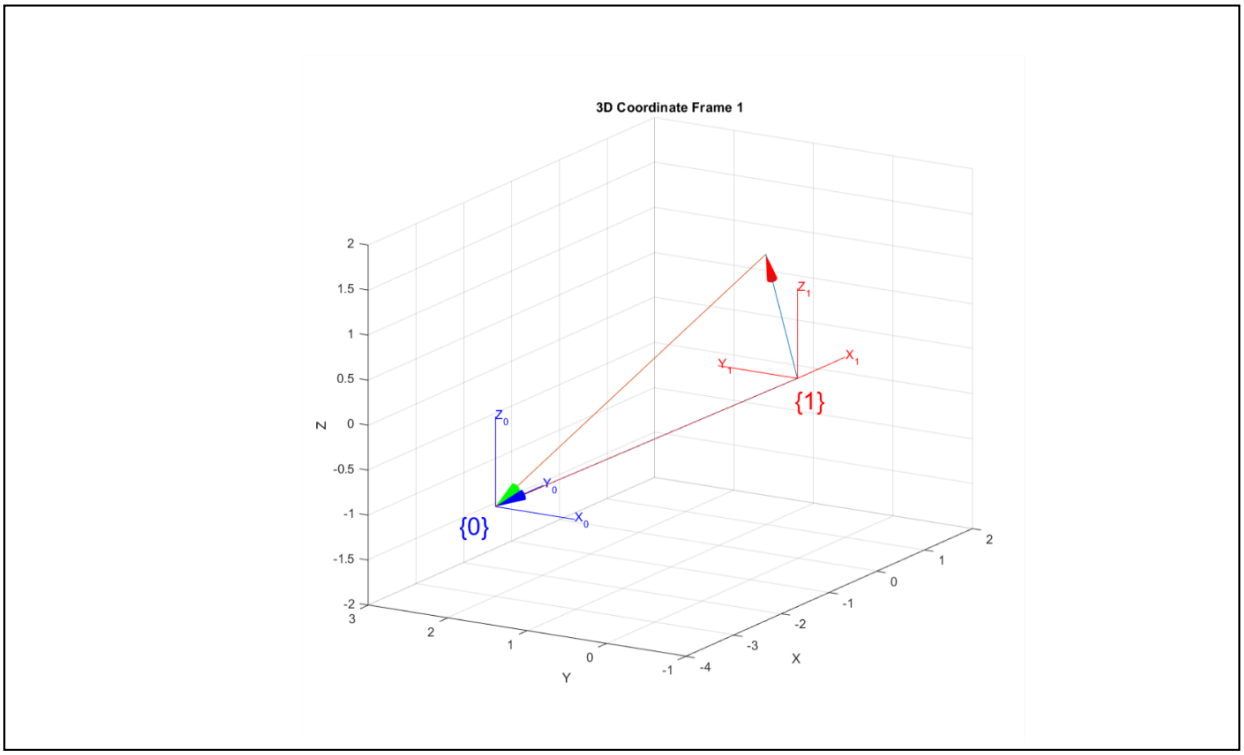
```
% 3.8
H_0_in_1 = inv(H_1_in_0);
disp('H_0_in_1 :');
disp(H_0_in_1);


% 3.9
trplot(H_0_in_1,'frame','0','color','b');

% 3.10
[R_0_in_1, t_0_in_1] = tr2rt(H_0_in_1 );
disp('t_0_in_1 :');
disp(t_0_in_1);
plot_arrow([0 0 0]', t_0_in_1,'b');

% 3.11
p_in_1 = [1; 1; 1];
plot_arrow([0 0 0], p_in_1, 'r');
plot_arrow(p_in_1,t_0_in_1,'g');
```

7. Final output MATLAB figure for the operations in 3.7 ~ 3.11.



8. Homogeneous transformation table.

Requirement	MATLAB script to satisfy the requirement	Homogeneous transformation matrix result

$o_0x_0y_0z_0$ to $o_1x_1y_1z_1$	`t0 = [0; 1; 1];`
	`R0 = [1 0 0;`
	`0 1 0;`
	`0 0 1];`
	
	`H_1_in_0 = rt2tr(R0, t0);  % H for frame {0} to frame {1}`
	`trplot(H_1_in_0,'color','b','frame','1','length',0.4,'thick',2);`
		1 0 0 0
		0 1 0 1
		0 0 1 1
		0 0 0 1

$o_0x_0y_0z_0$ to $o_2x_2y_2z_2$	`t1 = [-0.5; 0.5; 0];`
	`R1 = [1 0 0;`
	`0 1 0;`
	`0 0 1];`
	
	`H_2_in_1 = rt2tr(R1, t1);  % H for frame {1} to frame {2}`
	`H_2_in_0 = H_1_in_0*H_2_in_1;`
	`trplot(H_2_in_0,'color','b','frame','2','length',0.4,'thick',2);`
		1.0000 0 0 -0.5000
		0 1.0000 0 1.5000
		0 0 1.0000 1.0000
		0 0 0 1.0000

$o_0x_0y_0z_0$ to $o_3x_3y_3z_3$	`H_3_in_2 = rt2tr(R, t2);  % H for frame {2} to frame {3}`
	`H_3_in_0 = H_1_in_0*H_2_in_1*H_3_in_2;`
	`trplot(H_3_in_0,'color','r','frame','3','length',0.4,'thick',2);`
		0 1.0000 0 -0.5000
		1.0000 0 0 1.5000
		0 0 -1.0000 3.0000
		0 0 0 1.0000