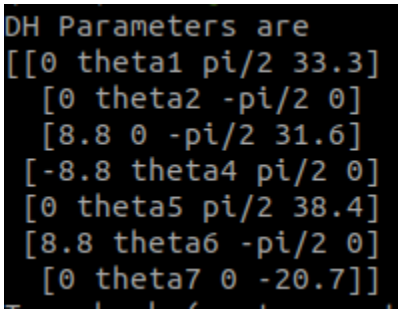
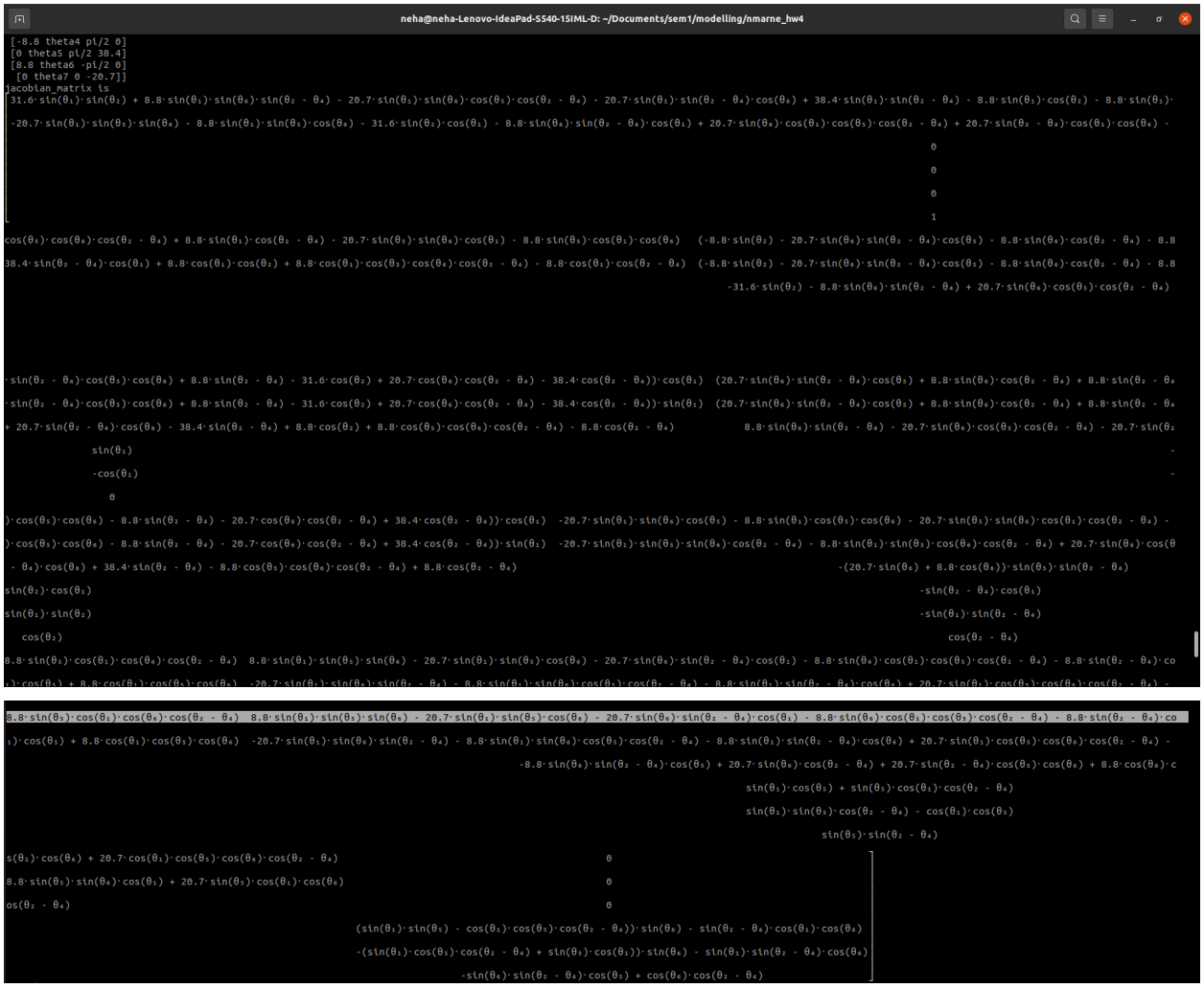
DH parameter(clearer images are provided in the image folder)



Jacobian Matrix(clearer images are provided in the image folder)



Method2 Used for setting up the jacobian

$$T_{i-1}^{i} = \begin{bmatrix} cos\theta_i & -cos\alpha_i sin\theta_i & sin\alpha_i sin\theta_i & a_i cos\theta_i \\ sin\theta_i & cos\alpha_i cos\theta_i & -sin\alpha_i cos\theta_i & a_i sin\theta_i \\ 0 & sin\alpha_i & cos\alpha_i & d_i \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

Transformation matrix of the above form was used for each frame transfer of frame
$\mathbf{Z}_i$ = first 3 elements of 3rd column of T^o_i
With Z_0 = [0 0 1]
$\mathbf{X_p}$ = first 3 aspects of 4th column of T_n^o
Jacobian =

$$^0_nJ = \begin{bmatrix} \frac{\partial^0 X_p}{\partial q_1} & \cdots & \frac{\partial^0 X_p}{\partial q_i} & \cdots & \frac{\partial^0 X_p}{\partial q_n} \\ {}^0Z_1 & \cdots & {}^0Z_i & \cdots & {}^0Z_n \end{bmatrix}$$

The equation used for the circle of motion

$y2 + (z - 72.5)2 = 100$
Velocity Equation

```
y_dot = 4.0*pi*sin(th)
z_dot = 4.0*pi*cos(th)
```

Inverse Kinematics Equation

$$\dot{q} = J^{-1}(q) * \dot{X}$$

With

$$\dot{X} = [v_x, v_y, v_z, \omega_x, \omega_y, \omega_z]^T$$

Joint angles were calculated using

$$q_{next} = q_{current} + \dot{q}_{next}\Delta t$$

Using these Joint angles positions of final end effector was obtained with following the equation of FK
X = T_n^o * q
This X was plotted using Matplot
Theta being updated by 2*pi/40(since I decided to sample the circle into 40 point) at each iteration for 5 sec

Final output