The resulting matrix **T0_E** is:

```
[cos(q2 + q3)*cos(q1), -sin(q2 + q3)*cos(q1),  sin(q1), cos(q1)*(cos(q2 + q3)*(l3^2 + l5^2)^(1/2) + cos(q2)*(l2^2 + l4^2)^(1/2))]
[cos(q2 + q3)*sin(q1), -sin(q2 + q3)*sin(q1), -cos(q1), sin(q1)*(cos(q2 + q3)*(l3^2 + l5^2)^(1/2) + cos(q2)*(l2^2 + l4^2)^(1/2))]
[        sin(q2 + q3),          cos(q2 + q3),        0,        l1 + sin(q2 + q3)*(l3^2 + l5^2)^(1/2) + sin(q2)*(l2^2 + l4^2)^(1/2)]
[                   0,                     0,        0,                                                                          1]
```

q1_sol = [atan2(Py, Px), pi + atan2(Py, Px)]

q2_sol = [atan2(Pz - l1, (Px^2 + Py^2)^(1/2)) - atan2(2*(1 - (Px^2 + Py^2 + l2^2 - l3^2 + l4^2 - l5^2 + (Pz - l1)^2)^2/(4*(l2^2 + l4^2)*(Px^2 + Py^2 + (Pz - l1)^2)))^(1/2), (Px^2 + Py^2 + l2^2 - l3^2 + l4^2 - l5^2 + (Pz - l1)^2)/((l2^2 + l4^2)^(1/2)*(Px^2 + Py^2 + (Pz - l1)^2)^(1/2))), atan2(Pz - l1, (Px^2 + Py^2)^(1/2)) - atan2(-2*(1 - (Px^2 + Py^2 + l2^2 - l3^2 + l4^2 - l5^2 + (Pz - l1)^2)^2/(4*(l2^2 + l4^2)*(Px^2 + Py^2 + (Pz - l1)^2)))^(1/2), (Px^2 + Py^2 + l2^2 - l3^2 + l4^2 - l5^2 + (Pz - l1)^2)/((l2^2 + l4^2)^(1/2)*(Px^2 + Py^2 + (Pz - l1)^2)^(1/2)))]

q3_sol = [atan2(2*(1 - (l2^2 - Py^2 - Px^2 + l3^2 + l4^2 + l5^2 - (Pz - l1)^2)^2/(4*(l2^2 + l4^2)*(l3^2 + l5^2)))^(1/2), -(l2^2 - Py^2 - Px^2 + l3^2 + l4^2 + l5^2 - (Pz - l1)^2)/((l2^2 + l4^2)*(l3^2 + l5^2))^(1/2)), atan2(-2*(1 - (l2^2 - Py^2 - Px^2 + l3^2 + l4^2 + l5^2 - (Pz - l1)^2)^2/(4*(l2^2 + l4^2)*(l3^2 + l5^2)))^(1/2), -(l2^2 - Py^2 - Px^2 + l3^2 + l4^2 + l5^2 - (Pz - l1)^2)/((l2^2 + l4^2)*(l3^2 + l5^2))^(1/2))]

-----------------Test case 1-----------------

Px, Py, Pz from forward kinematic

Px = 0.94528

Py = 0.39966

Pz = 0.59145

q1, q2, q3 from inverse kinematic

q1_sol =

    0.4000   3.5416

q1_val = 0.4

q2_sol =

    0.2000   0.5288

q2_val = 0.2

q3_sol =

    0.3000   -0.3000

q3_val = 0.3

Verifying Px, Py, and Pz from inverse kinematics

Solution 1: q1 = 0.4000, q2 = 0.2000, q3 = 0.3000

Px_sol1 = 0.94528

Py_sol1 = 0.39966

Pz_sol1 = 0.59145

Solution 2: q1 = 0.4000, q2 = 0.5288, q3 = -0.3000

Px_sol2 = 0.94528

Py_sol2 = 0.39966

Pz_sol2 = 0.59145

Solution 3: q1 = 3.5416, q2 = 2.9416, q3 = -0.3000

Px_sol3 = 0.94528

Py_sol3 = 0.39966

Pz_sol3 = 0.59145

Solution 4: q1 = 3.5416, q2 = 2.6128, q3 = 0.3000

Px_sol4 = 0.94528

Py_sol4 = 0.39966

Pz_sol4 = 0.59145

-----------------Test case 2-----------------

Px, Py, Pz from forward kinematic

Px = 0.51295

Py = -0.38995

Pz = 0.50355

q1, q2, q3 from inverse kinematic

q1_sol =

-0.6500 2.4916

q1_val = -0.65

q2_sol =

-0.1000 1.3876

q2_val = -0.1

q3_sol =

1.2000 -1.2000

q3_val = 1.2

Verifying Px, Py, and Pz from inverse kinematics

Solution 1: q1 = -0.6500, q2 = -0.1000, q3 = 1.2000

Px_sol1 = 0.51295

Py_sol1 = -0.38995

Pz_sol1 = 0.50355

Solution 2: q1 = -0.6500, q2 = 1.3876, q3 = -1.2000

Px_sol2 = 0.51295

Py_sol2 = -0.38995

Pz_sol2 = 0.50355

Solution 3: q1 = 2.4916, q2 = 3.2416, q3 = -1.2000

Px_sol3 = 0.51295

Py_sol3 = -0.38995

Pz_sol3 = 0.50355

Solution 4: q1 = 2.4916, q2 = 1.7540, q3 = 1.2000

Px_sol4 = 0.51295

Py_sol4 = -0.38995

Pz_sol4 = 0.50355

-----------------Test case 3-----------------

Px, Py, Pz from forward kinematic

Px = -0.31682

Py = 0.081202

Pz = 0.905

q1, q2, q3 from inverse kinematic

q1_sol =

2.8907   6.0323

q1_val = -0.2509

q2_sol =

0.5008   1.7895

q2_val = 1.3521

q3_sol =

0.8300   -0.8300

q3_val = 0.83

Verifying Px, Py, and Pz from inverse kinematics

Solution 1: q1 = 2.8907, q2 = 0.5008, q3 = 0.8300

Px_sol1 = -0.31682

Py_sol1 = 0.081202

Pz_sol1 = 0.905

Solution 2: q1 = 2.8907, q2 = 1.7895, q3 = -0.8300

Px_sol2 = -0.31682

Py_sol2 = 0.081202

Pz_sol2 = 0.905

Solution 3: q1 = 6.0323, q2 = 2.6408, q3 = -0.8300

Px_sol3 = -0.31682

Py_sol3 = 0.081202

Pz_sol3 = 0.905

Solution 4: q1 = 6.0323, q2 = 1.3521, q3 = 0.8300

Px_sol4 = -0.31682

Py_sol4 = 0.081202

Pz_sol4 = 0.905

-----------------Test case 4-----------------

Px, Py, Pz from forward kinematic

Px = 0.75506

Py = 0.15479

Pz = 0.55174

q1, q2, q3 from inverse kinematic

q1_sol =

    0.2022   3.3438

q1_val = 0.2022

q2_sol =

    0.0275   0.6242

q2_val = 0.6242

q3_sol =

    0.9485   -0.9485

q3_val = -0.9485

Verifying Px, Py, and Pz from inverse kinematics

Solution 1: q1 = 0.2022, q2 = 0.0275, q3 = 0.9485

Px_sol1 = 0.75506

Py_sol1 = 0.15479

Pz_sol1 = 0.55174

Solution 2: q1 = 0.2022, q2 = 0.6242, q3 = -0.9485

Px_sol2 = 0.75506

Py_sol2 = 0.15479

Pz_sol2 = 0.55174

Solution 3: q1 = 3.3438, q2 = 3.1141, q3 = -0.9485

Px_sol3 = 0.75506

Py_sol3 = 0.15479

Pz_sol3 = 0.55174

Solution 4: q1 = 3.3438, q2 = 2.5174, q3 = 0.9485

Px_sol4 = 0.75506

Py_sol4 = 0.15479

Pz_sol4 = 0.55174

-----------------Test case 5-----------------

Px, Py, Pz from forward kinematic

Px = 0.77785

Py = -0.3211

Pz = 0.18612

q1, q2, q3 from inverse kinematic

q1_sol =

-0.3915   2.7501

q1_val = -0.3915

q2_sol =

0.0743   0.1426

q2_val = 0.0743

q3_sol =

0.0799   -0.0799

q3_val = 0.0799

Verifying Px, Py, and Pz from inverse kinematics

Solution 1: q1 = -0.3915, q2 = 0.0743, q3 = 0.0799

Px_sol1 = 0.77785

Py_sol1 = -0.3211

Pz_sol1 = 0.18612

Solution 2: q1 = -0.3915, q2 = 0.1426, q3 = -0.0799

Px_sol2 = 0.77785

Py_sol2 = -0.3211

Pz_sol2 = 0.18612

Solution 3: q1 = 2.7501, q2 = 3.0673, q3 = -0.0799

Px_sol3 = 0.77785

Py_sol3 = -0.3211

Pz_sol3 = 0.18612

Solution 4: q1 = 2.7501, q2 = 2.9990, q3 = 0.0799

Px_sol4 = 0.77785

Py_sol4 = -0.3211

Pz_sol4 = 0.18612