We have recurrence relation

$$a_n = -3a_{n-1} - 3a_{n-2} - a_{n-3}$$

Characteristic polynomial:

$$\lambda^3 + 3\lambda^2 + 3\lambda + 1 = 0$$

$$(\lambda + 1)^3 = 0$$

$$\lambda = -1$$

SO we have one root $\lambda = -1$ with the 3rd multiplicity.

So the solution of the relation is

$$a_n = (-1)^n(c_1 + c_2 n + c_3 n^2)$$

Substituting initial conditions we get:

$$a_0 = c_1 = 1$$

$$a_1 = -1(c_1 + c_2 + c_3) = -2$$

$$a_2 = c_1 + 2c_2 + 4c_3 = -1$$

Substituting $c_1 = 1$ into the 2nd and 3rd equations we get:

$$c_2 + c_3 = 1$$

$$c_2 + 2c_3 = -1$$

Solving this system we get:

$$c_1 = 1$$

$$c_2 = 3$$

$$c_3 = -2$$

Thus the solution of the recurrence relation is

$$a_n = (-1)^n(1 + 3n - 2n^2)$$