```
clc; clear; close all;

syms V_in V_out V_x V_s1 R_1 R_2 R_D1 R_D2 g_m1 g_m2 r_o I_D2 R_1p2 gain_1
gain_2 open_loop_gain

% stage 1
eqn1 = -V_x / R_D1 == V_s1 / (R_1p2);
eqn2 = V_s1 / (R_1p2) == g_m1 * (V_in - V_s1) + (V_x - V_s1) / r_o;
eqn_gain1 = gain_1 == V_x / V_in;

sol_gain_1 = solve([eqn1, eqn2, eqn_gain1], [gain_1, V_x, V_in])

% stage 2
eqn3 = -V_out / R_D2 == V_out / (R_1 + R_2) + I_D2;
eqn4 = I_D2 == g_m2 * V_x + V_out / r_o;
eqn_gain2 = gain_2 == V_out / V_x;

sol_gain_2 = solve([eqn3, eqn4, eqn_gain2], [gain_2, V_out, V_x])

% open loop gain
eqn_open_loop_gain = open_loop_gain == gain_1 * gain_2;

sol_open_loop_gain = solve([eqn1, eqn2, eqn3, eqn4, eqn_gain1, eqn_gain2,
eqn_open_loop_gain], [open_loop_gain, gain_1, gain_2, V_out, V_in])

fprintf('Gain 1: \n')
pretty(sol_gain_1.gain_1)
fprintf('Gain 2: \n')
pretty(sol_gain_2.gain_2)
fprintf('Open Loop Gain: \n')
pretty(sol_open_loop_gain.open_loop_gain)
```

```
sol_gain_1 =

  struct with fields:

    gain_1: -(R_D1*g_m1*r_o)/(R_1p2 + R_D1 + r_o + R_1p2*g_m1*r_o)
       V_x: -(R_D1*V_s1)/R_1p2
      V_in: (R_1p2*V_s1 + R_D1*V_s1 + V_s1*r_o + R_1p2*V_s1*g_m1*r_o)/(R_1p2…


sol_gain_2 =

  struct with fields:

    gain_2: -(g_m2*r_o*(R_1*R_D2 + R_2*R_D2))/(R_1*R_D2 + R_2*R_D2 + R_1*r_o…
     V_out: -(I_D2*R_1*R_D2 + I_D2*R_2*R_D2)/(R_1 + R_2 + R_D2)
       V_x: (I_D2*R_1*R_D2 + I_D2*R_2*R_D2 + I_D2*R_1*r_o + I_D2*R_2*r_o + I…


sol_open_loop_gain =
```

```
  struct with fields:

    open_loop_gain: [0×1 sym]
            gain_1: [0×1 sym]
            gain_2: [0×1 sym]
             V_out: [0×1 sym]
              V_in: [0×1 sym]

Gain 1:
             R_D1 g_m1 r_o
- ----------------------------------
  R_1p2 + R_D1 + r_o + R_1p2 g_m1 r_o

Gain 2:
            g_m2 r_o (R_1 R_D2 + R_2 R_D2)
- ------------------------------------------------
  R_1 R_D2 + R_2 R_D2 + R_1 r_o + R_2 r_o + R_D2 r_o

Open Loop Gain:
()
```

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