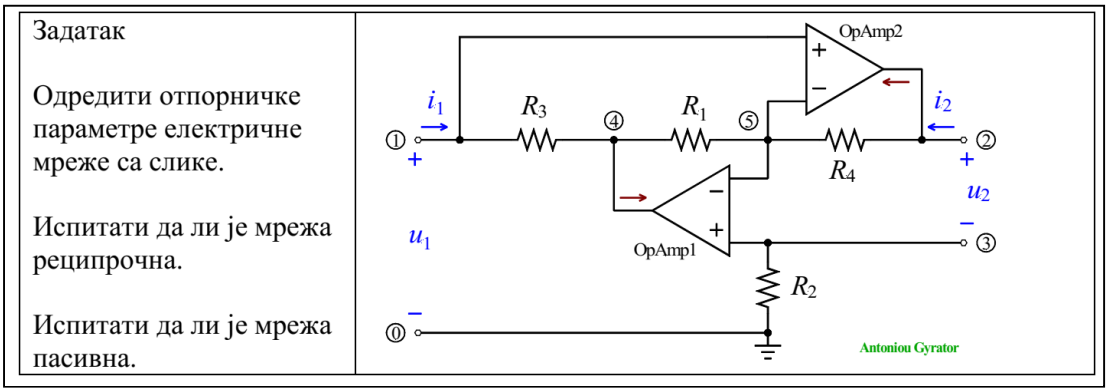
Figure 1: Antoniou Gyrator




```
(%i1) jednacine: [-i1 + (v1-v4)/R3 = 0,
                  -i2 + (v2-v5)/R4 + iopAmp2 = 0, v1-v5 = 0,
                   i2 + v3/R2 = 0,
                  (v4-v1)/R3 + (v4-v5)/R1 + iopAmp1 = 0, v3-v5 = 0,
                  (v5-v4)/R1 + (v5-v2)/R4 = 0];
```

$$(\%o1)\quad \left[\frac{v1-v4}{R3}-i1=0,\frac{v2-v5}{R4}+iopAmp2-i2=0,v1-v5=0,\frac{v3}{R2}+i2=0,\frac{v4-v5}{R1}+\frac{v4-v1}{R3}+iopAmp1=0,v3-v5=0,\frac{v5-v4}{R1}+\frac{v5-v2}{R4}=0\right]$$

```
(%i2) promenljive: [v1, v2, v3, v4, v5, iopAmp1, iopAmp2];
```

$$(\%o2)\quad [v1,v2,v3,v4,v5,iopAmp1,iopAmp2]$$

```
(%i3) odziv: linsolve(jednacine, promenljive);
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$$(\%o3)\quad \left[v1=-R2\,i2,v2=\frac{R3\,R4\,i1-R1\,R2\,i2}{R1},v3=-R2\,i2,v4=-R2\,i2-R3\,i1,v5=-R2\,i2,iopAmp1=\frac{(R3+R1)\,i1}{R1},iopAmp2=-\frac{R3\,i1-R1\,i2}{R1}\right]$$

```
(%i4) u1: ev(v1, odziv);
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$$(\%o4)\quad -R2\,i2$$

```
(%i5) u2: ev(v2-v3, odziv), ratsimp;
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$$(\%o5)\quad \frac{R3\,R4\,i1}{R1}$$

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(%i6) r11: u1, [i1 = 1, i2 = 0];
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$$(\%o6)\quad 0$$

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(%i7) r12: u1, [i1 = 0, i2 = 1];
```

$$(\%o7)\quad -R2$$

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(%i8) r21: u2, [i1 = 1, i2 = 0];
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$$(\%o8)\quad \frac{R3\,R4}{R1}$$

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(%i9) r22: u2, [i1 = 0, i2 = 1];
(%o9) 0

(%i10) is(r12 = r21);
(%o10) false

(%i11) r: matrix([r11, r12], [r21, r22]);
```

$$(\%o11)\quad \begin{pmatrix} 0 & -R2 \\ \frac{R3\,R4}{R1} & 0 \end{pmatrix}$$

```
(%i12) assume(R1>0, R2>0, R3>0, R4>0);
(%o12) [R1 > 0, R2 > 0, R3 > 0, R4 > 0]

(%i13) Dis: (r12+r21)^2 - 4·r11·r22;
```

$$(\%o13)\quad \left(\frac{R3\,R4}{R1} - R2\right)^2$$

```
(%i14) is(r11 >= 0 and r22 >= 0 and Dis <= 0);
(%o14) unknown

(%i15) assume(notequal(R3·R4/R1, R2));
```

$$(\%o15)\quad \left[\mathrm{notequal}\left(\frac{R3\,R4}{R1}, R2\right)\right]$$

```
(%i16) is(r11 >= 0 and r22 >= 0 and Dis <= 0);
(%o16) false
```