

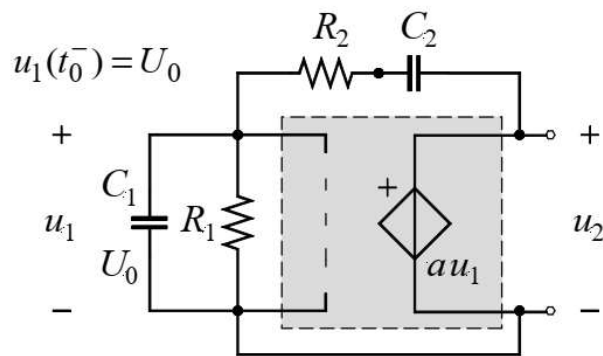
# Одзив на почетне услове

Figure 1: Wien-bridge Oscillator

Вредности елемената електричног кола са слике су познате.

$$R_1 = R_2 = R, C_1 = C_2 = C, a = 3.$$

- (а) Колико главних пресека има граф кола?
- (б) Одредити једначине стања у матричном облику.
- (в) Одредити и нацртати напон  $u_2$  за  $t > t_0$ ,  $t_0 = 0$ .



Винов осцилатор (Wien bridge oscillator).

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(%i1) jednacine: [i1+i2+i3+i5=0,
                 -i4+i6+i7=0,
                 -i3+i4=0,
                 u1-u2=0,
                 u2-u5=0,
                 u5-u6-u4-u3=0,
                 u6-u7=0,
                 i1=C1*'diff(u1,t),
                 u2=R1*i2,
                 u3=R2*i3,
                 i4=C2*'diff(u4,t),
                 i5=0,
                 u6=a*u5,
                 u7=R3*i7];

(%o1) [i5+i3+i2+i1=0, i7+i6-i4=0, i4-i3=0, u1-u2=0, u2
       -u5=0, -u6+u5-u4-u3=0, u6-u7=0, i1=C1*(d/dt u1), u2=R1 i2
       , u3=R2 i3, i4=C2*(d/dt u4), i5=0, u6=a u5, u7=R3 i7]
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(%i2) jednacineDu1Du4: jednacine, 'diff(u1,t)=Du1, 'diff(u4,t)=Du4;
(%o2) [i5+i3+i2+i1=0, i7+i6-i4=0, i4-i3=0, u1-u2=0, u2
-u5=0, -u6+u5-u4-u3=0, u6-u7=0, i1=C1 Du1, u2=R1 i2, u3=
R2 i3, i4=C2 Du4, i5=0, u6=a u5, u7=R3 i7]

(%i3) JednacineIzvoda: eliminate(jednacineDu1Du4,
[i1, i2, i3, i4, i5, i6, i7, u2, u3, u5, u6, u7]);
(%o3) [R1 R2 (R2+R1) (u4+(-C2 Du4-C1 Du1) R1 a+C2 Du4 R2+
(C2 Du4+C1 Du1) R1), -(R2+R1)
(R1 u4+R1 a u1-R1 u1+R2 (-u1-C1 Du1 R1)) ]

(%i4) jednacineStanja: linsolve(JednacineIzvoda, [Du1, Du4]);
(%o4) [Du1= $\frac{R1 u4+R1 a u1-R2 u1-R1 u1}{C1 R1 R2}$ , Du4= $-\frac{u4+a u1-u1}{C2 R2}$ ]

(%i5) jednacineDiff: jednacineStanja,
Du1='diff(u1, t),
Du4='diff(u4, t);
(%o5) [ $\frac{d}{dt} u1 = \frac{R1 u4+R1 a u1-R2 u1-R1 u1}{C1 R1 R2}$ ,  $\frac{d}{dt} u4 = -$ 
 $\frac{u4+a u1-u1}{C2 R2}$ ]

(%i6) zamene: [R1=R, R2=R, R3=R, C1=C, C2=C, a=3];
(%o6) [R1=R, R2=R, R3=R, C1=C, C2=C, a=3]

(%i7) jednacineDiffZamene:jednacineDiff, zamene, [u1=u1(t), u4=u4(t)];
(%o7) [ $\frac{d}{dt} u1(t) = \frac{R u4(t)+R u1(t)}{C R^2}$ ,  $\frac{d}{dt} u4(t) = -$ 
 $\frac{u4(t)+2 u1(t)}{C R}$ ]

(%i8) atvalue(u1(t), t=0,U0);
(%o8) U0

(%i9) atvalue(u4(t), t=0,0);
(%o9) 0

(%i10) assume(R>0, C>0);
(%o10) [R>0, C>0]

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(%i11) odziv: desolve(jednacinDiffZamene, [u1(t), u4(t)]), ratsimp;
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(%o11) 
$$\left[ u_1(t) = U_0 \sin\left(\frac{t}{CR}\right) + U_0 \cos\left(\frac{t}{CR}\right), u_4(t) = -2 U_0 \sin\left(\frac{t}{CR}\right) \right]$$

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(%i12) vrednosti: [R=1000, C=10^(-6), U0=10];
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(%o12) 
$$[R=1000, C=\frac{1}{1000000}, U_0=10]$$

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(%i13) uC1:u1(t), odziv, vrednosti;
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(%o13) 
$$10 \sin(1000 t) + 10 \cos(1000 t)$$

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(%i14) wxplot2d([3·uC1], [t,0,0.02],
                [xlabel," t [s] "],
                [ylabel," u2 [V] "],
                [legend, "Napon u2(t)", grid2d]) $
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(%t14)
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