Tema I Bazele Electrotehnicii

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Anul I

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Cuprins

1 Exercitiul 1

1.1 Circuit electric liniar rezisitiv

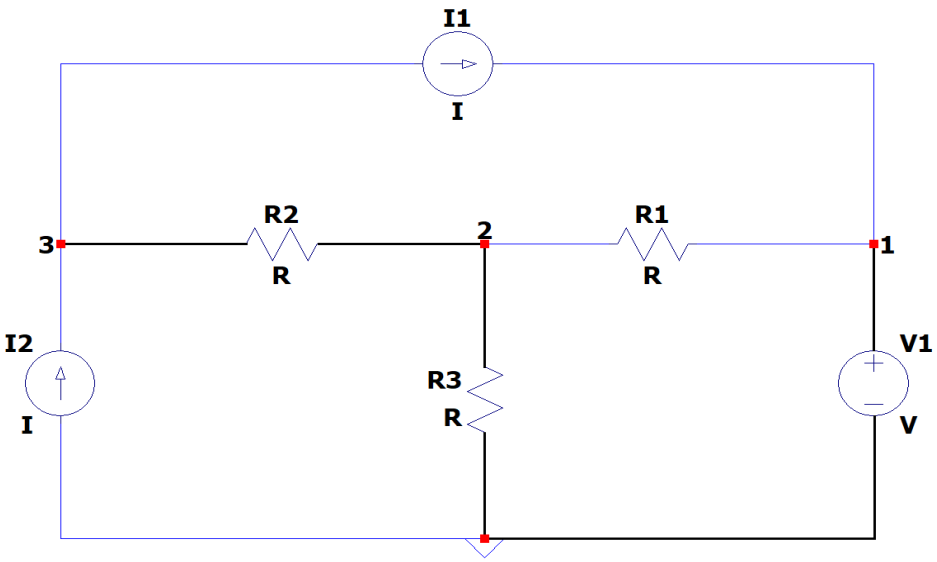

Figura 1: Circuit electric liniar rezisitiv

Am generat un circuit liniar cu **N = 4 noduri** , **L = 6 laturi** , **N -1 = 3 ramuri** si **3 coarde**. Circuitul contine 2 surse ideale de curent (SIC) , 2 surse ideale de tensiune (SIT) si 3 rezistori (R). Am ales un graf in interiorul circuitului , care sa nu se inchida , marcat in desen de laturile de culoare neagra .

1.2 Graful Tensiunilor

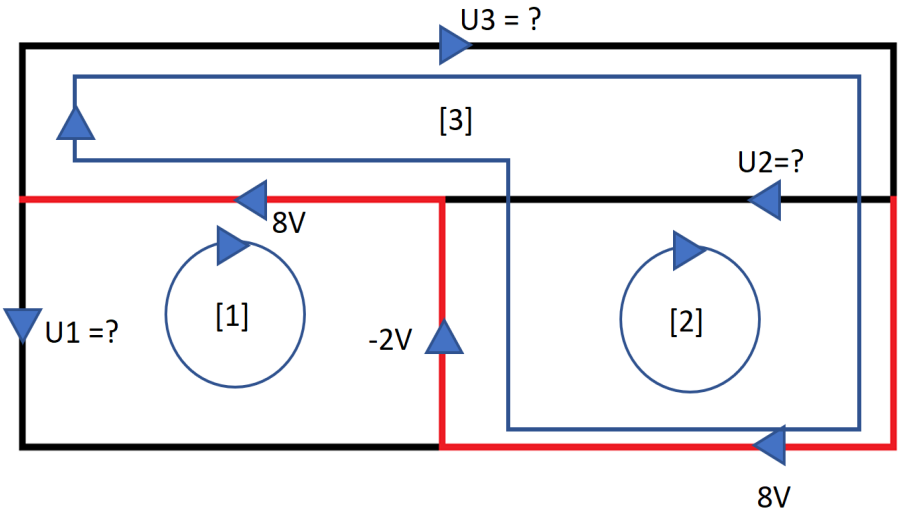

Figura 2: Graful Tensiunilor

Pentru bucla [1] vom avea
U1 + 8 -2 = 0
U1 + 6 = 0
U1 = -6
Pentru bucla [2] vom avea
U2 - 8 + 2 = 0
U2 -6 = 0
U2 = 6
Pentru bucla [3] vom avea
-U3 - 8 + 2 - 8 = 0
-U3 - 16 + 2 =0
-U3 -14 = 0
U3 = -14

1.3 Graful Intensitatilor

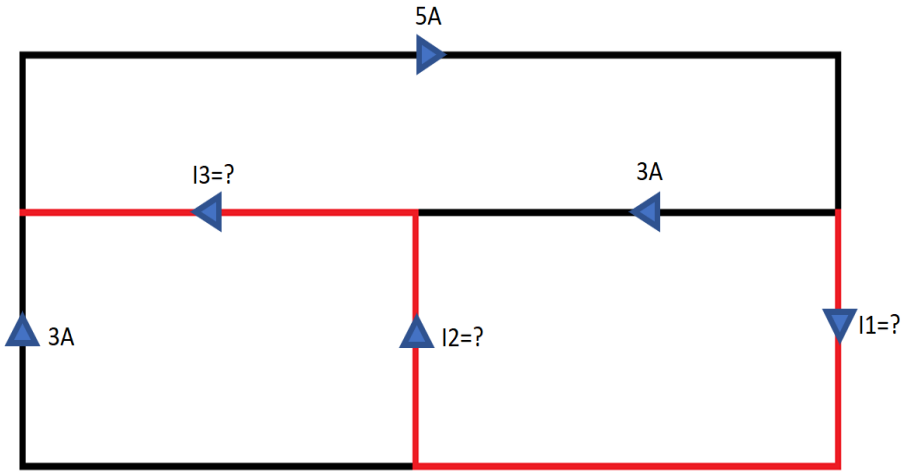

Figura 3: Graful Intensitatilor

Calculez parametrii elementelor de pe laturi:

$$I1 + 3 = 5 \Rightarrow I1 = 5 - 3 \Rightarrow I1 = 2A$$

$$I2 + 3 = I1 \Rightarrow I2 = I1 - 3 \Rightarrow I2 = 2 - 3 \Rightarrow I2 = -1A$$

$$I3 + 3 = 5 \Rightarrow I3 = 5 - 3 \Rightarrow I3 = 2A$$

Calculez parametrii elementelor de pe laturi:

$$R1 = \frac{U2}{3} = \frac{6}{3} = 2\Omega$$

$$R2 = \frac{8}{I3} = \frac{8}{2} = 4\Omega$$

$$R3 = \frac{-2}{I2} = \frac{-2}{-1} = 2\Omega$$

2 Metode sistematice eficiente

Pentru **Kirchhoff clasic** voi avea **2L = 12 ecuatii** .
Pentru **Kirchhoff in curenti** voi avea **L - N +1 = 3 ecuatii** .
Pentru **Kirchhoff in tensiuni** voi avea **N - 1 = 3 ecuatii** .
Pentru **Curenti de coarde** voi avea **L - N +1 - NRsic = 1 ecuatie** .
Pentru **Tensiuni in ramuri** voi avea **N - 1 - NRsit = 2 ecuatie** .

Cea mai eficienta metoda este cea a **curentilor prin coarde** .

2.1 Graful marcat cu Sectiuni

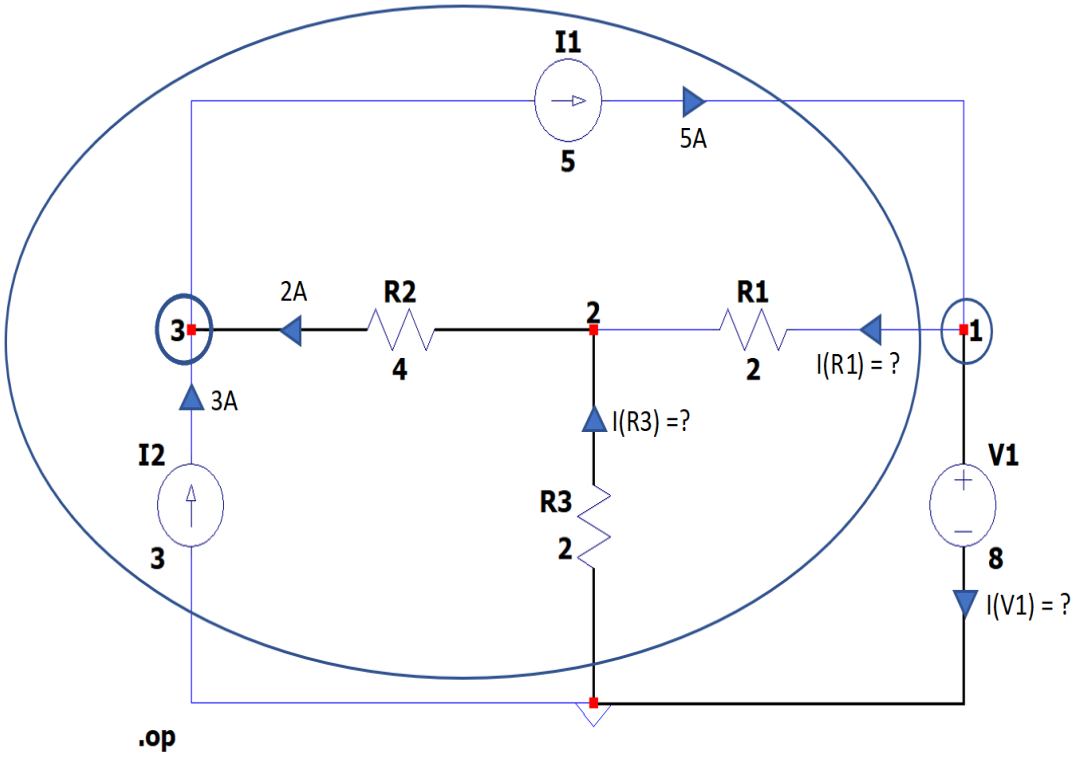

Figura 4: Graf cu Sectiuni

$$I(R1) + I(V1) = 5A \Rightarrow I(V1) = 5 - I(R1) \Rightarrow I(V1) = 5 - 2 + I(R3) \Rightarrow I(V1) = 3 + I(R3)$$

$$I(R1) + I(R3) = 2A \Rightarrow I(R1) = 2 - I(R3)$$

2.2 Graful marcat cu Bucla

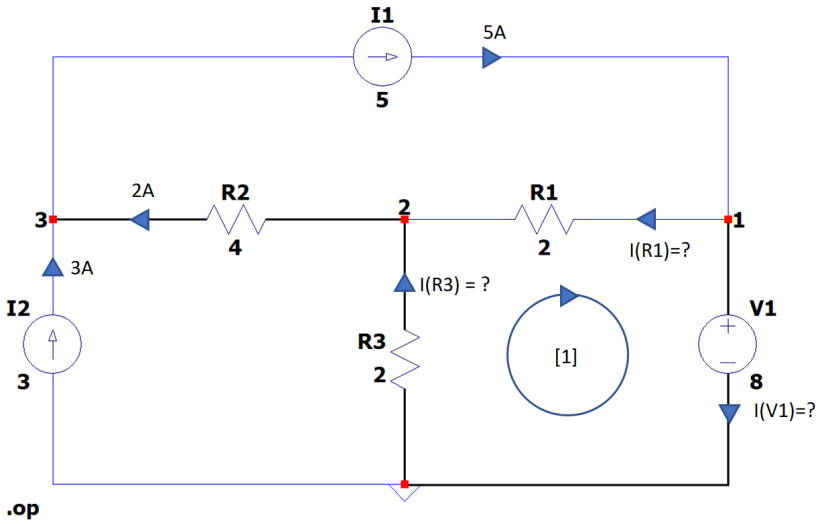

Figura 5: Graf cu Bucla

$$I(R3)*R3-I(R1)*R1 = V1 \Rightarrow I(R3)*R3-[2-I(R3)]*R1 = V1 \Rightarrow 2I(R3)-4+2I(R3) = -8 \Rightarrow I(R3) = -1A$$

Vom avea ca rezultat :
I(R1) = 2 + 1
I(R1) = 3A
I(V1) = 3 - 1
I(V1) = 2A

2.3 Verificarea Bilantului de Puteri

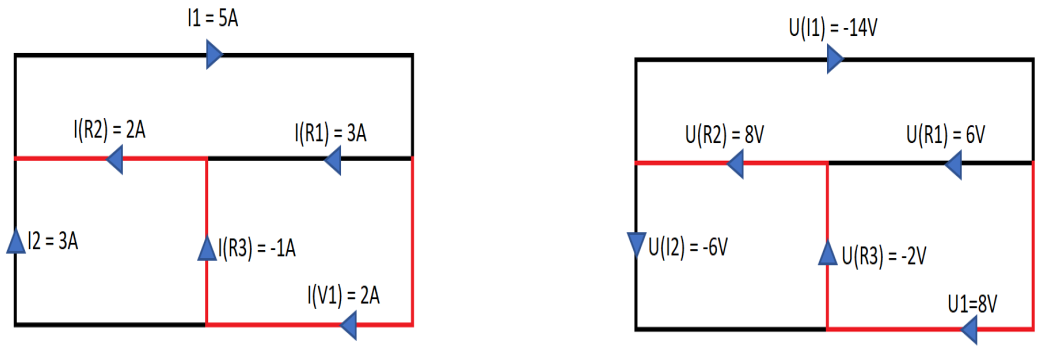

Figura 6: Graful Intensitatii si Graful Tensiunii

$$Pc = I(R1)^2 \times R1 + I(R2)^2 \times R2 + I(R3)^2 \times R3 = 4 \times 4 + 9 \times 2 + 2 \times 1 = 16 + 18 + 2 = 36W$$

$$Pg = -I1 \times U(I1) - I(V1) \times U(V1) - I2 \times U(I2) = 70 - 18 - 16 = 36W$$

3 Generatorul echivalent de tensiune/curent

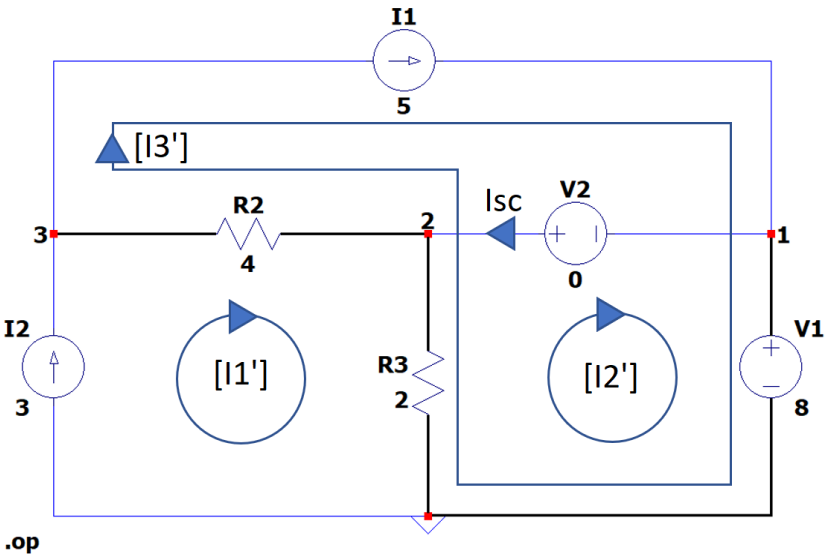

Figura 7: Circuitul Scurcircuitat

$$R11 \times I1' + R12 \times I2' + R13 \times I3' = E1'$$

$$R21 \times I1' + R22 \times I2' + R23 \times I3' = E2'$$

$$R31 \times I1' + R32 \times I2' + R33 \times I3' = E3'$$

$$I1' = 3A$$
$$I3' = 5A$$

$$R12 = R21 = 2$$
$$R13 = R31 = -6$$
$$R23 = R32 = 2$$

$$R22 = 2$$

$$10 + 2I2' + 6 = 8 \Rightarrow I2' = -4A$$

Intensitatea de scurcircuit este :

$$Isc = -I2' - I1' + I3' \Rightarrow Isc = 4 - 3 + 5 \Rightarrow Isc = 6A$$

Rezistenta echivalenta este o rezistenta paralela :

$$R120 = \frac{R2 + R3}{R2 \times R3} = \frac{4 + 2}{4 \times 2} = \frac{6}{8} = \frac{3}{4} = 0.75\Omega$$

$$U120 = \frac{Isc}{\frac{1}{R120} + \frac{1}{R12}}$$

$$U120 = \frac{6}{\frac{1}{\frac{3}{4}} + \frac{1}{2}} = \frac{6}{\frac{1}{0.75} + \frac{1}{2}} \approx 3.27V$$

3.1 Graficul Dependentelor

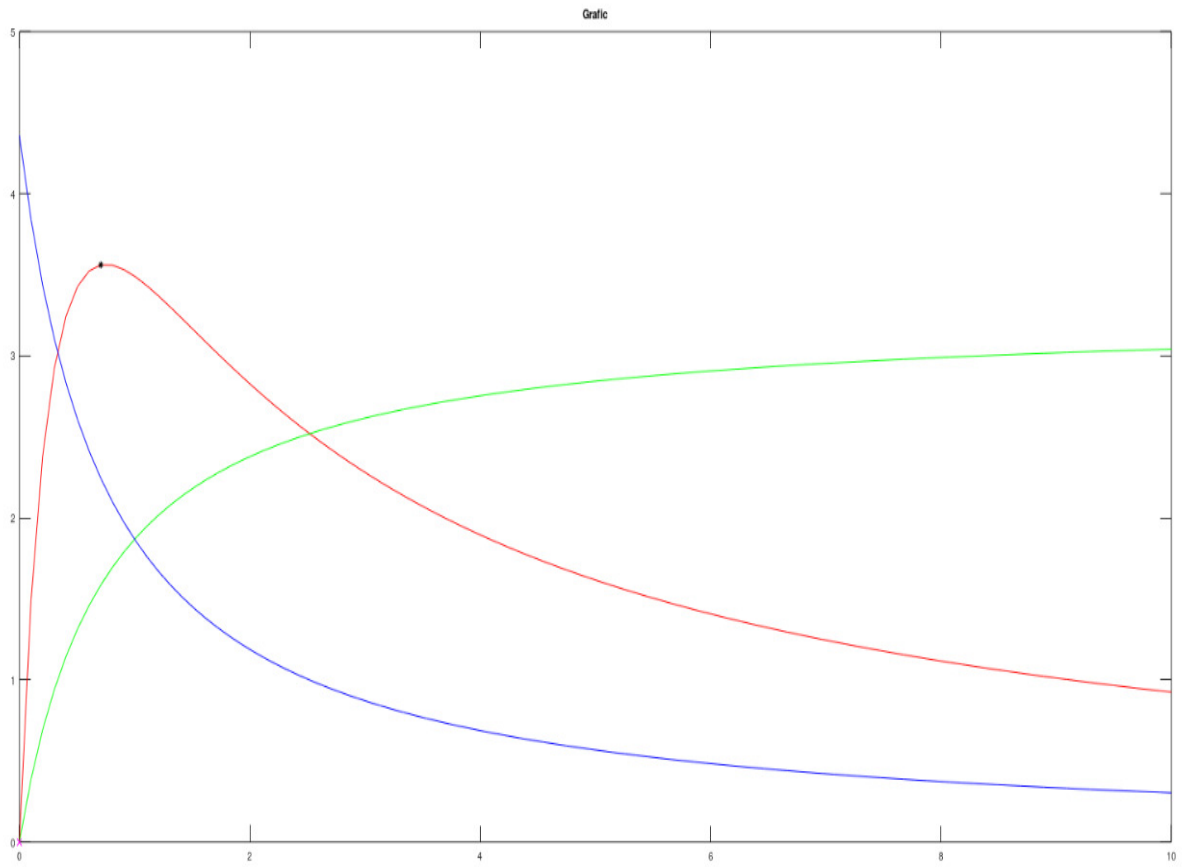

Figura 8: Graficul Intensitatii , Puterii si al Tensiunii

Curba marcata cu rosu reprezinta Graficul Puterii

Curba marcata cu verde reprezinta Graficul Tensiunii

Curba marcata cu albastru reprezinta Graficul Intensitatii

Punctul in care se realizeaza transferul maxim de putere este dat de coordonatele x=0.71 si y =21.3

In punctul initial de functionare al rezistorului , tensiunea are valoarea y= 4.4 , iar puterea si intensitatea y = 0

3.2 Graficul Intensitatii

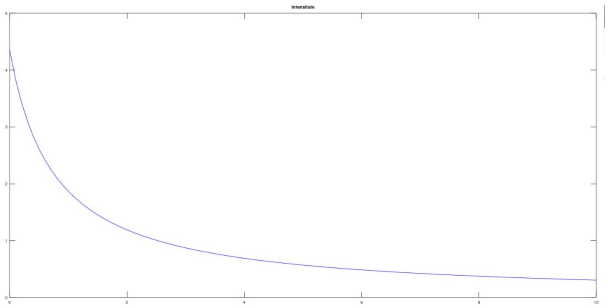

Figura 9: Graficul Intensitatii

3.3 Graficul Tensiunii

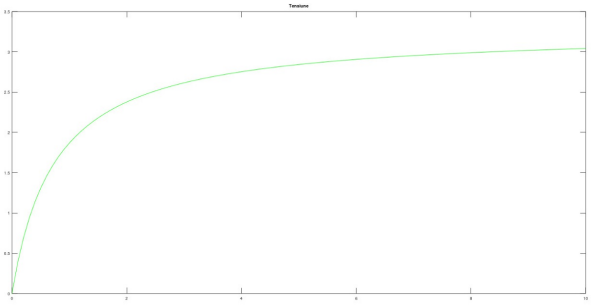

Figura 10: Graficul Tensiunii

3.4 Graficul Puterii

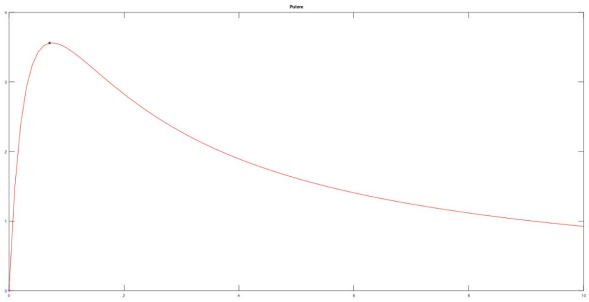

Figura 11: Graficul Puterii

```
function Putere(R120,U120)
 R = linspace(0,10,100);

 for i = 1:100

   if( i == 1 )

     I = U120 / (R(i) + R120);
     U = I(i) * R(i);
     P = U(i) * I(i);

   else

     I = [ I , U120 / (R(i) + R120) ];
     U = [ U , I(i) * R(i) ];
     P = [ P , U(i) * I(i) ];

   endif

 endfor

 Pmax = max(P);
 idx = find(P == Pmax);

 y = P(idx);
 x = R(idx);

 figure(1);
 plot(R,P,"r");
 hold on
 plot(x,y,'k*');
 plot(0,P(1),'mx');
 title ("Putere");

 figure(2);
 plot(R,U,"g");
 title ("Tensiune");

 figure(3);
 plot(R,I,"b");
 title ("Intensitate");

 figure(4);
 plot(R,P,"r",R,U,"g",R,I,"b");
 hold on
 plot(x,y,'k*');
 plot(0,P(1),'mx');
 title ("Grafic");

endfunction
```

3.5 Caracteristica rezistorului liniar si caracteristica generatorului echivalent

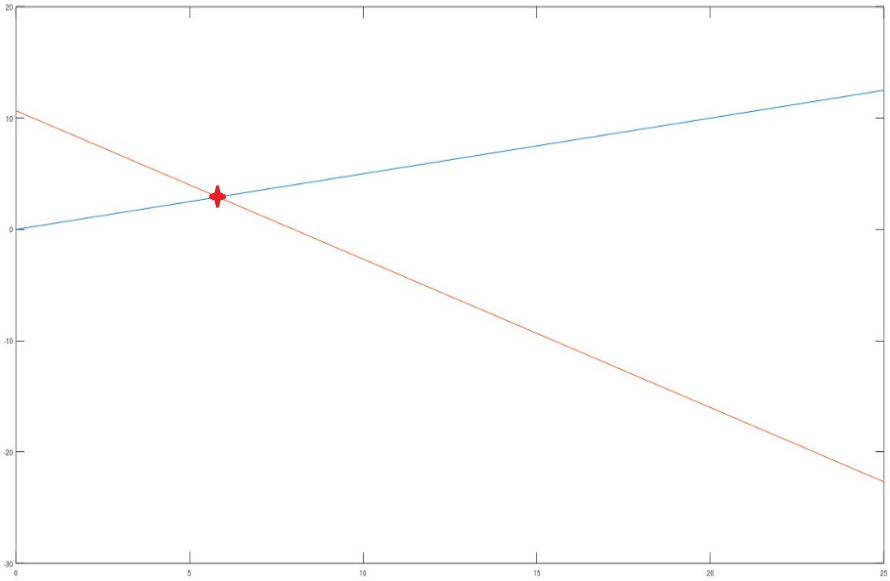

Figura 12: Graficul Caracteristicilor

```
1
2  function   caract()
3
4          U = linspace(0,25,100);
5          R1 = 2;
6          R120 = 0.75;
7          Ee = 8;
8
9          for i = 1:100
10
11                 if(i == 1)
12
13                         I = U(i)/R1;
14                         Id = (Ee - U(i) )/R120;
15
16                 else
17
18                         I = [I , U(i)/R1];
19                         Id = [Id , (Ee - U(i) )/R120];
20
21                 endif
22
23         endfor
24
25         plot(U,I,U,Id);
26
27 endfunction
```

3.6 Dioda Semiconductoare

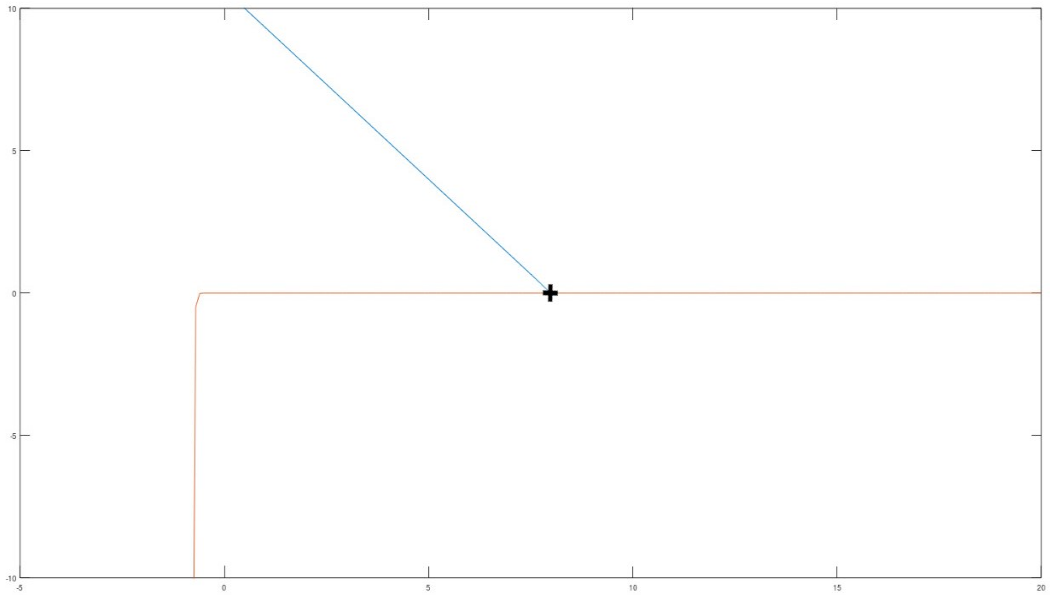

Figura 13: Graficul Metodei Inverse

```
1
2  function MetodaDiodaIndirecta(Ee,R120)
3
4    R = linspace(0,100,100);
5
6    for i = 1 : 100
7
8      I1(i) = Ee / ( R120 + R(i) );
9      U1(i) = I1(i) * R(i);
10
11   endfor
12
13   U = -20 : 0.1 : 20;
14   I = -10^(-12) * ( exp( U / 0.026 ) - 1 );
15
16   plot( U1 , I1 );
17   hold on
18   plot( -U , I );
19
20   xlim([-5;20]);
21   ylim([-10;10]);
22
23 endfunction
```

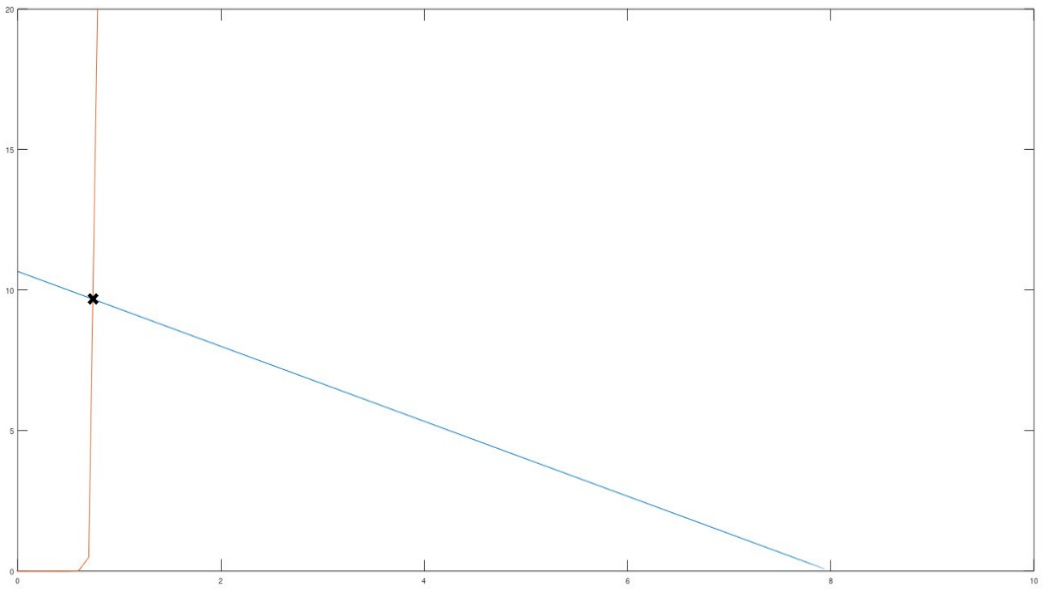

Figura 14: Graficul Metodei Directe

```
1
2  function MetodaDiodaDirecta(Ee,Rab)
3
4    R = linspace(0,100,100);
5
6    for i = 1 : 100
7
8      I1(i) = Ee / ( R(i) + Rab );
9      U1(i) = I1(i) * R(i);
10
11   endfor
12
13   U = -20 : 0.1 : 20;
14   I =  10^(-12) * ( exp( U / 0.026 ) - 1 );
15
16   plot( U1 , I1 );
17   hold on
18   plot( U , I );
19
20   ylim([-0 20]);
21   xlim([-0 10]);
22
23 endfunction
```

4 Exercitiul 4

4.1 Surse Comandate

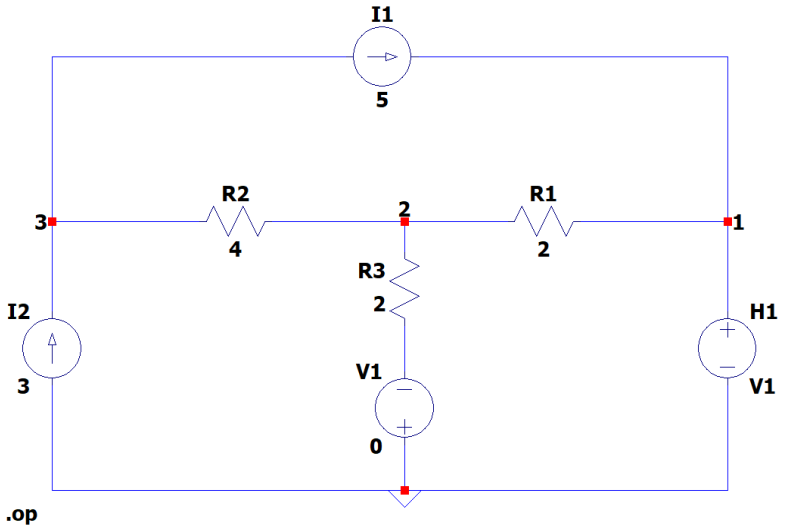

Figura 15: Circuitul dupa transformarea unui SIT in SUCI

$$Rtransfer = \frac{V1}{I(R3)} = \frac{8}{-1} = -8\Omega$$

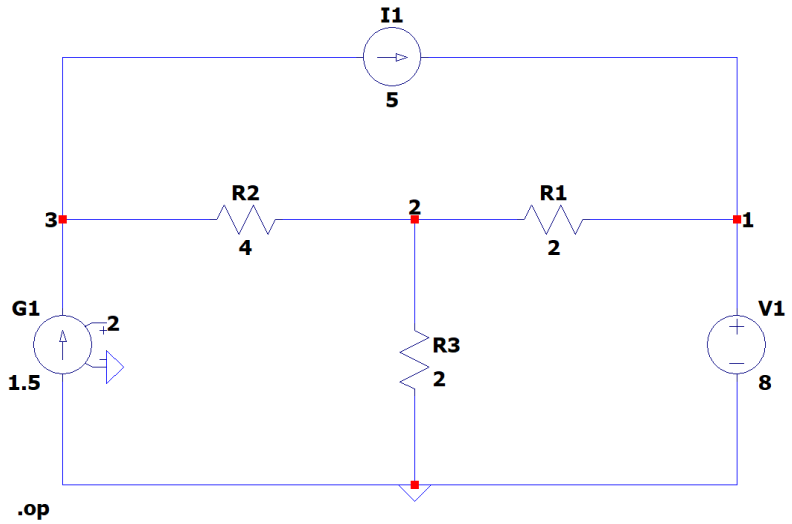

Figura 16: Circuitul dupa transformarea unui SIC in SICU

$$Conductantdetransfer = \frac{I2}{R3} = \frac{3}{2} = 1.5\frac{A}{V}$$

4.2 Simulare LTspice

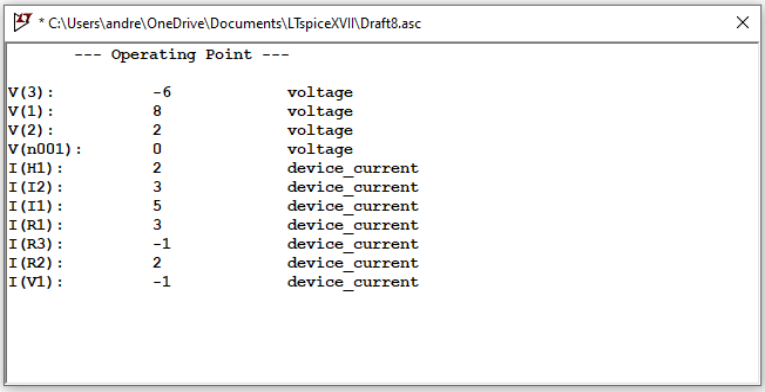

Figura 17: Valori SICU

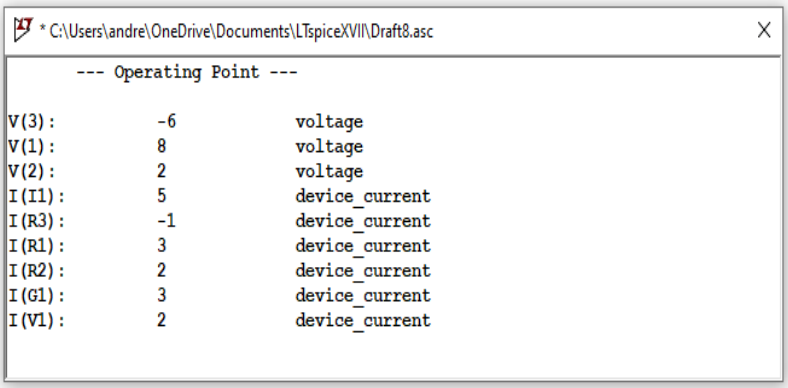

Figura 18: Valori SICU

5 Exercitiul 5

5.1 Pagina de inceput

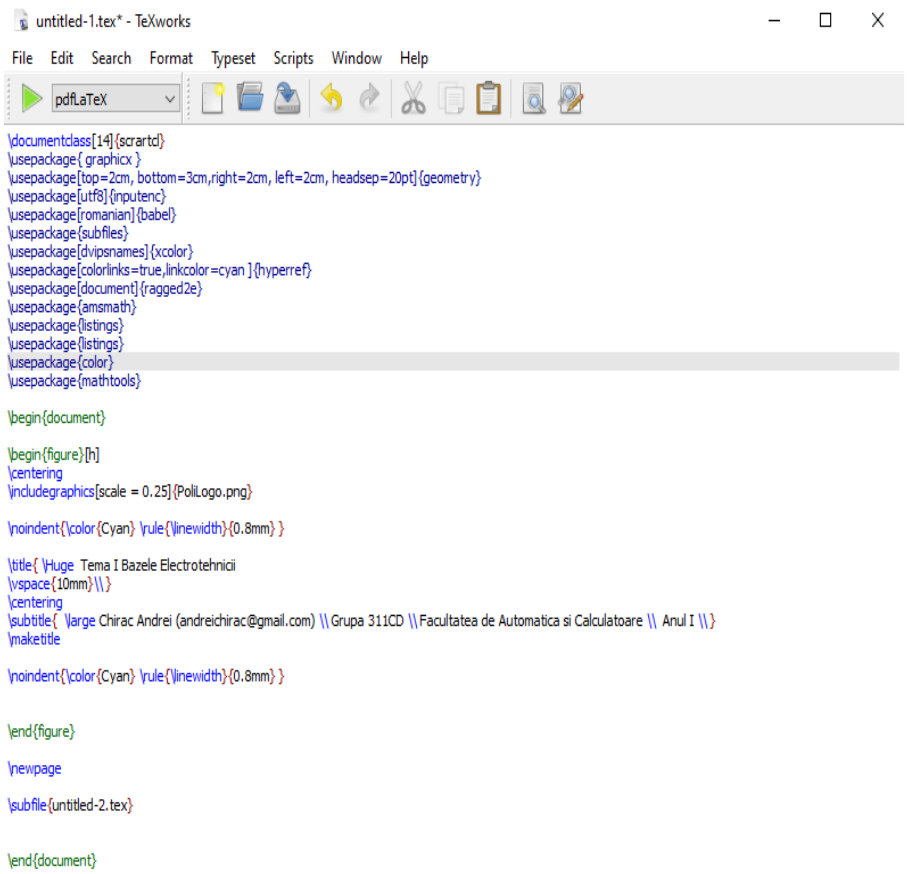

Figura 19: Codul Latex pentru pagina de inceput

5.2 Continutul lucrarii

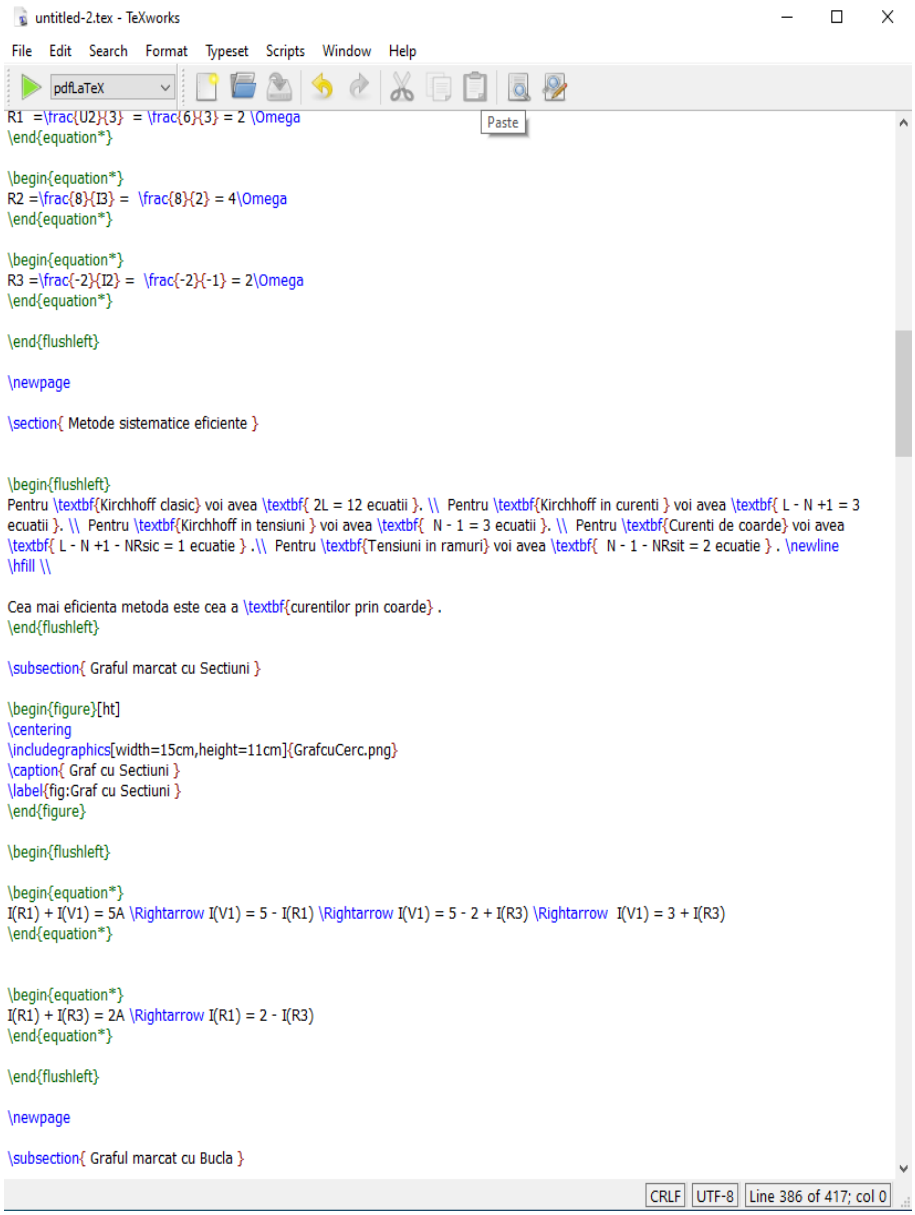

Figura 20: O parte din codul Latex pentru continutul lucrarii

5.3 Implementate in octave

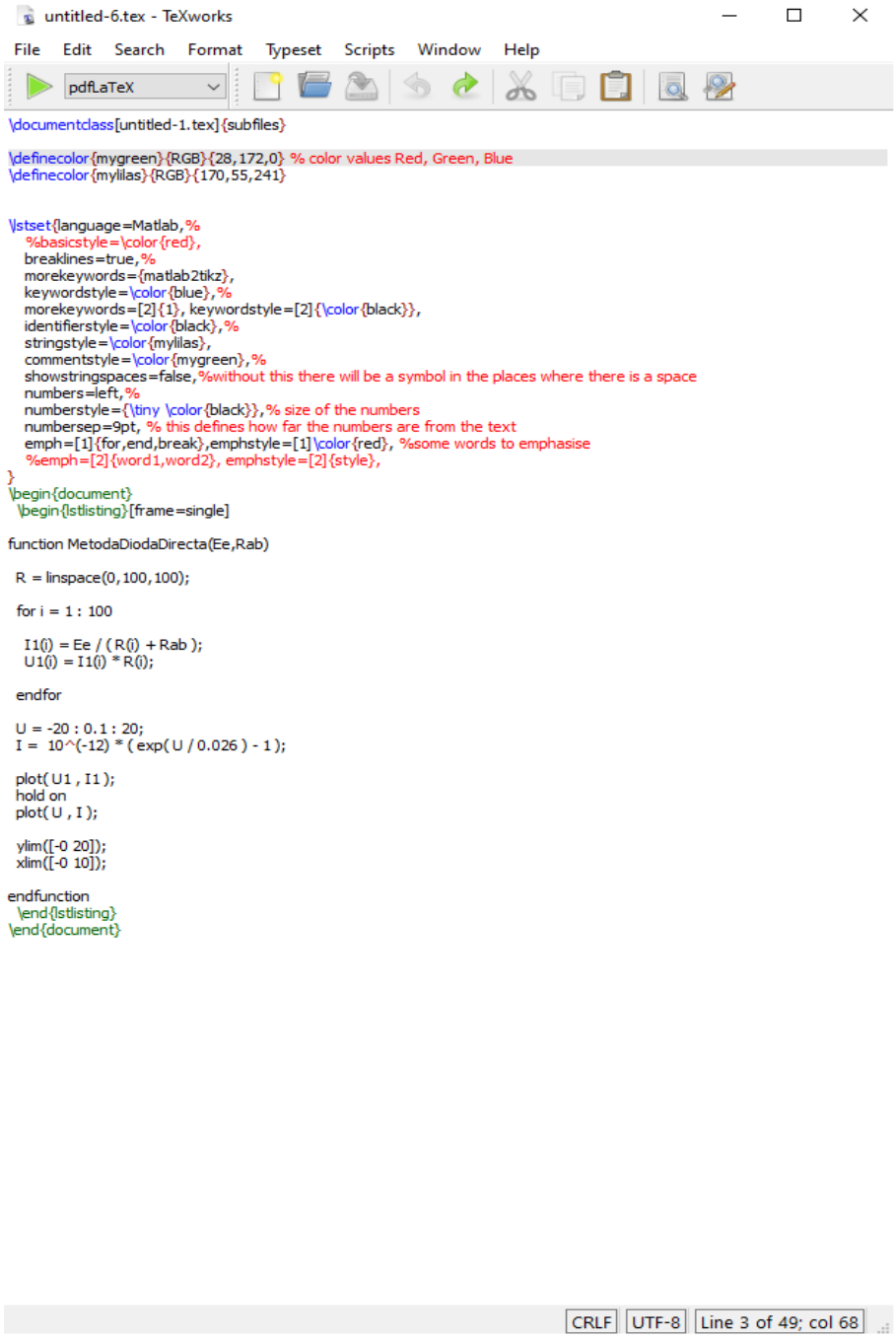

Figura 21: Codul Latex pentru una dintre functiile implementate in octave

6 Bibliografie

Aurel Sorin Lup
Planse de seminar - Metode de analiza a circuitelor electrice

Mihai Popescu
Tutorial video Laborator 2

Ajutor in limabjul LaTeX
Disponibil la https://www.overleaf.com/learn

G. Ciuprina, A. Gheorghe, M. Popescu, D. Niculae, A.S. Lup, R. Barbulescu, D. Ioan
Modelarea si simularea circuitelor electrice. Indrumar de laborator pe care il putem gasi la :
https://acs.curs.pub.ro/2019/pluginfile.php/60444/mod_resource/content/5/indrumar_draft_19februarie2016.pdf