

ECE 111 - Homework #13

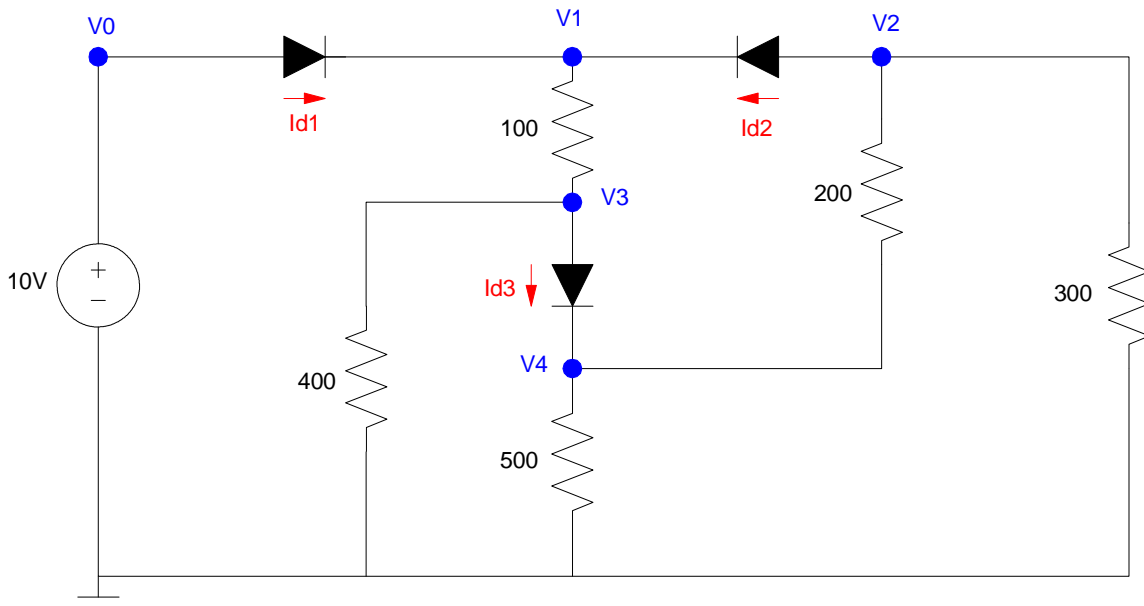
Week #13 - ECE 320 Electronics I. Due 8am, Tuesday April 19th

Please submit as a Word or pdf file to BlackBoard or email to Jacob_Glower@yahoo.com with header ECE 111 HW#13
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Assume the VI characteristics for 1N4004 diodes are:

$$V_d = 0.038 \cdot \ln \frac{I_d}{7.7 \cdot 10^{-11}} + 1 \quad I_d = 7.7 \cdot 10^{-11} \exp \frac{V_d}{0.038} - 1$$

1) Write the voltage node equations for the following circuit.



$$I_{d1} = 7.7 \cdot 10^{-11} \exp \frac{V_0 - V_1}{0.038} - 1$$

$$I_{d2} = 7.7 \cdot 10^{-11} \exp \frac{V_2 - V_1}{0.038} - 1$$

$$I_{d3} = 7.7 \cdot 10^{-11} \exp \frac{V_3 - V_4}{0.038} - 1$$

$$-I_{d1} - I_{d2} + \frac{V_1 - V_3}{100} = 0$$

$$I_{d2} + \frac{V_2 - V_4}{200} + \frac{V_2}{300} = 0$$

$$\frac{V_3 - V_1}{100} + \frac{V_3}{400} + I_{d3} = 0$$

$$-I_{d3} + \frac{V_4 - V_2}{200} + \frac{V_4}{500} = 0$$

2) Solve using fminsearch and MATLAB

Create an m-file for the previous 7 equations

```
function [ J ] = Diode3( z )
    V0 = 10;
    V1 = z(1);
    V2 = z(2);
    V3 = z(3);
    V4 = z(4);

    Idss = 7.7e-11;
    nVt = 0.038;

    Id1 = Idss* exp( (V0 - V1)/nVt - 1 );
    Id2 = Idss* exp( (V2 - V1)/nVt - 1 );
    Id3 = Idss* exp( (V3 - V4)/nVt - 1 );

    e1 = -Id1 -Id2 + (V1-V3)/100;
    e2 = Id2 + (V2-V4)/200 + V2/300;
    e3 = (V3-V1)/100 + (V3/400) + Id3;
    e4 = -Id3 + (V4-V2)/200 + V4/500;

    J = (e1)^2 + (e2)^2 + (e3)^2 + (e4)^2;

    disp([V1, V2, V3, V4, log10(J)])
    pause(0.1)

end
```

Solve using fminsearch

```
>> [V,e] = fminsearch('Diode3',[4,3,2,1])

    V1      V2      V3      V4      log10(J)
    4.0000    3.0000    2.0000    1.0000   116.0500
    4.2000    3.0000    2.0000    1.0000   111.4785
    4.0000    3.1500    2.0000    1.0000   116.0500
    :
    :
    9.2051    2.9955    5.7666    4.9924  -11.6517
    9.2052    2.9955    5.7666    4.9924  -12.3449
    9.2052    2.9954    5.7665    4.9923  -12.6476

V =      V1      V2      V3      V4
    9.2051    2.9954    5.7666    4.9924

e = 1.1655e-013
```

3) Check your results using CircuitLab

- Use 1N4004 diodes

	V0	V1	V2	V3	V4
Calculated	10.000V	9.2051V	2.9954V	5.7666V	4.9924V
Simulated	10.000V	9.256V	3.037V	5.785V	5.062V

