

ECE 310 MICROELECTRONICS I

LOAD LINE ANALYSIS

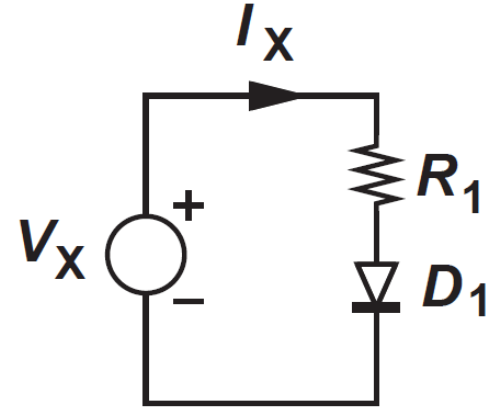
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LOAD LINE ANALYSIS

- Graphical method to solve circuits with non-linear device characteristics.
- Solve graphically for:
- $I_D = f(V) = (V_X - V)/R$
- $f(V) = I_S * (\exp(V/v_T) - 1)$



MATLAB CODE

```
clc; close all; clear all;
```

```
mA = 1e-3;  
vT = 0.026;
```

```
Is = 1e-15;  
R = 1e3;  
Vx = 3;
```

```
V=[0:0.01:Vx];
```

```
% Diode equation
```

```
f1=@(V) (Is*(exp(V/vT)-1));
```

```
% Load line equation
```

```
f2=@(V) (Vx-V)/R;
```

```
% Graphical solution
```

```
VD = fzero(@(V)f1(V)-f2(V),0.5); %starts search from V==0.5
```

```
ID = f1(VD)/mA;
```

```
% Plot the curves
```

```
figure();
```

```
plot(V, f1(V)/mA, 'r', 'linewidth', 2);
```

```
hold on; grid on;
```

```
plot(V, f2(V)/mA, 'b', 'linewidth', 2);
```

```
% Add marker and text
```

```
plot(VD, ID,'ko')
```

```
txt2 = ['V_D = ', num2str(VD), 'V, I_D = ', num2str(ID), ' mA'];
```

```
text(VD+0.5,ID+0.5,txt2)
```

```
title('Load Line Analysis');
```

```
xlabel('V_D, V')
```

```
ylabel('I_D, mA')
```

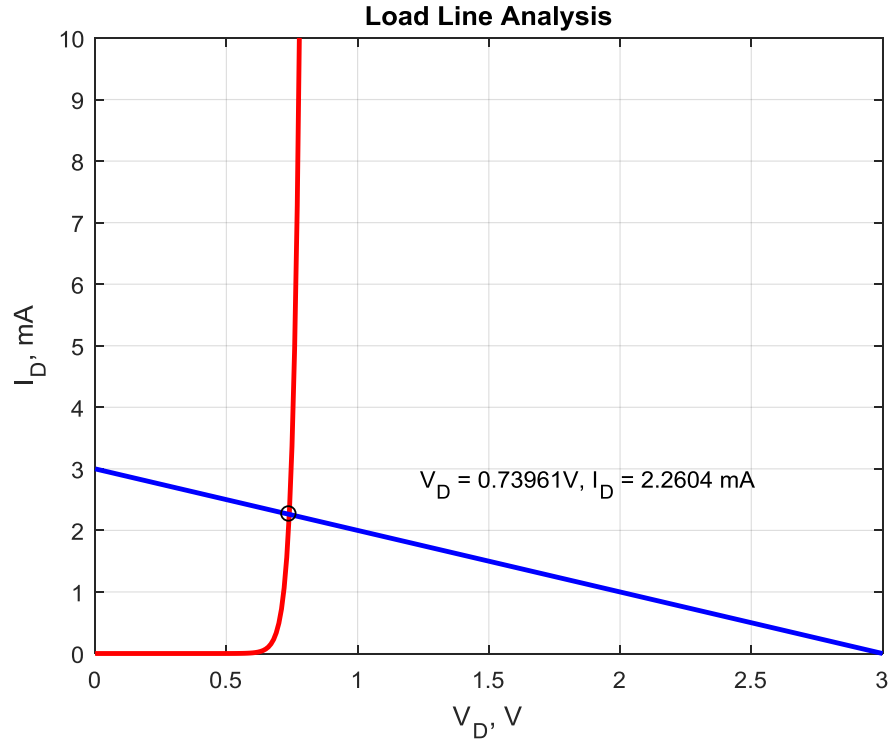
```
xlim([0 Vx]);
```

```
ylim([0 10]);
```

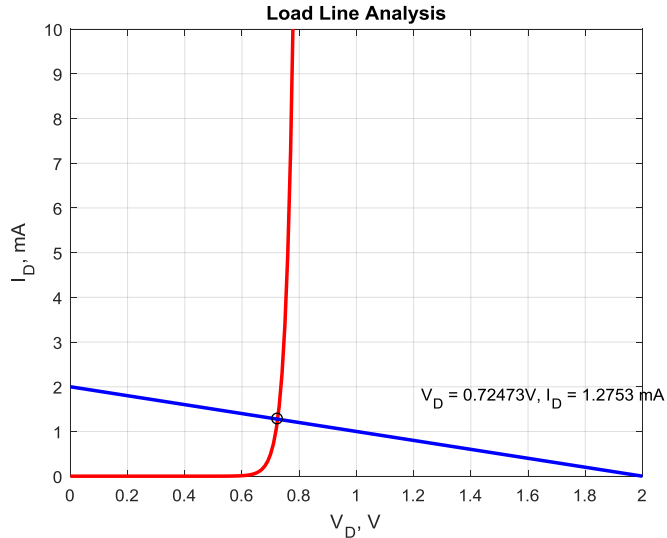


LOAD LINE ANALYSIS CONTD.

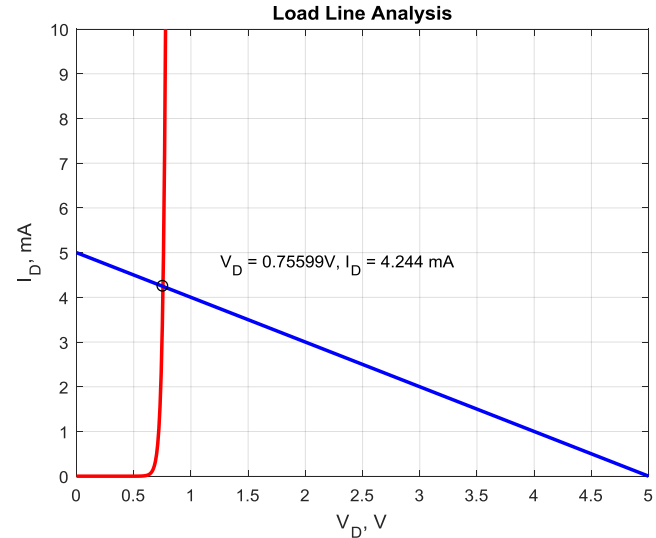
$I_s = 1e-15;$
 $R = 1e3;$
 $V_x = 3;$



LOAD LINE ANALYSIS CONTD.



$I_s = 1\text{e-}15$;
 $R = 1\text{e}3$;
 $V_x = 2$;



$I_s = 1\text{e-}15$;
 $R = 1\text{e}3$;
 $V_x = 5$;

