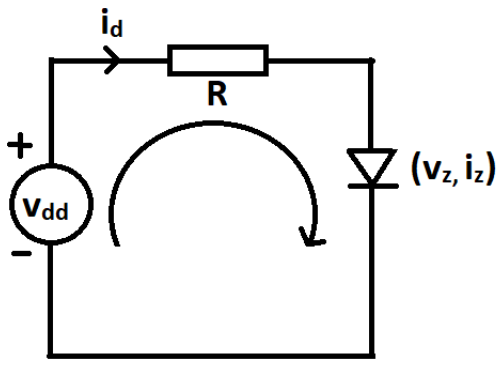
Assignment 4:

- **Usman Ul Muazzam**

To find the current in the circuit using KVL and validate it using load line method



- v_{dd} = Applied DC bias
- R = Resistance
- v_z = Voltage across diode
- $i_z = i_d$ = current in the diode (circuit)

In [1]:

```
using Plots
include("NewtonRaphson.jl")
```

Out[1]:

```
NewtonRaphson (generic function with 1 method)
```

In [2]:

```
using SymPy
```

In [3]:

```
v=Sym("v")
```

Out[3]:

v

In [4]:

```
η=1
I0=50e-9
R=1000
vdd=2
T=300
vt=0.026*T/(300);
```

KVL

- $v_{dd} - i_d R - v_z = 0$

  $i_d = i_z = I_0(e^{\frac{v_z}{\eta v_t}} - 1)$

  $\therefore v_{dd} - I_0(e^{\frac{v_z}{\eta v_t}} - 1)R - v = 0$

In [5]:

```
f(v)=vdd - I0*(exp(v/(η*vt)) -1)*R - v
```

Out[5]:

```
f (generic function with 1 method)
```

In [6]:

```
y=NewtonRaphson(f,0);
```

In [7]:

```
I(x)=I0*(exp(x/(η*vt)) -1)

println("Current in the circuit is: ",round(I(y)*1000,digits=3)," mA")
```

```
Current in the circuit is: 1.728 mA
```

Load line analysis

In [8]:

```
VD=[]
ID=[]
for vd in 0.5:0.5:10
    f(v)=vd - I0*(exp(v/(η*vt)) -1)*R - v
    y=NewtonRaphson(f,0)
    push!(VD,y)
    push!(ID,I(y))
end
```

Equation of load line

- $i_z = -\frac{1}{R}(v_z - v_{dd})$

In [9]:

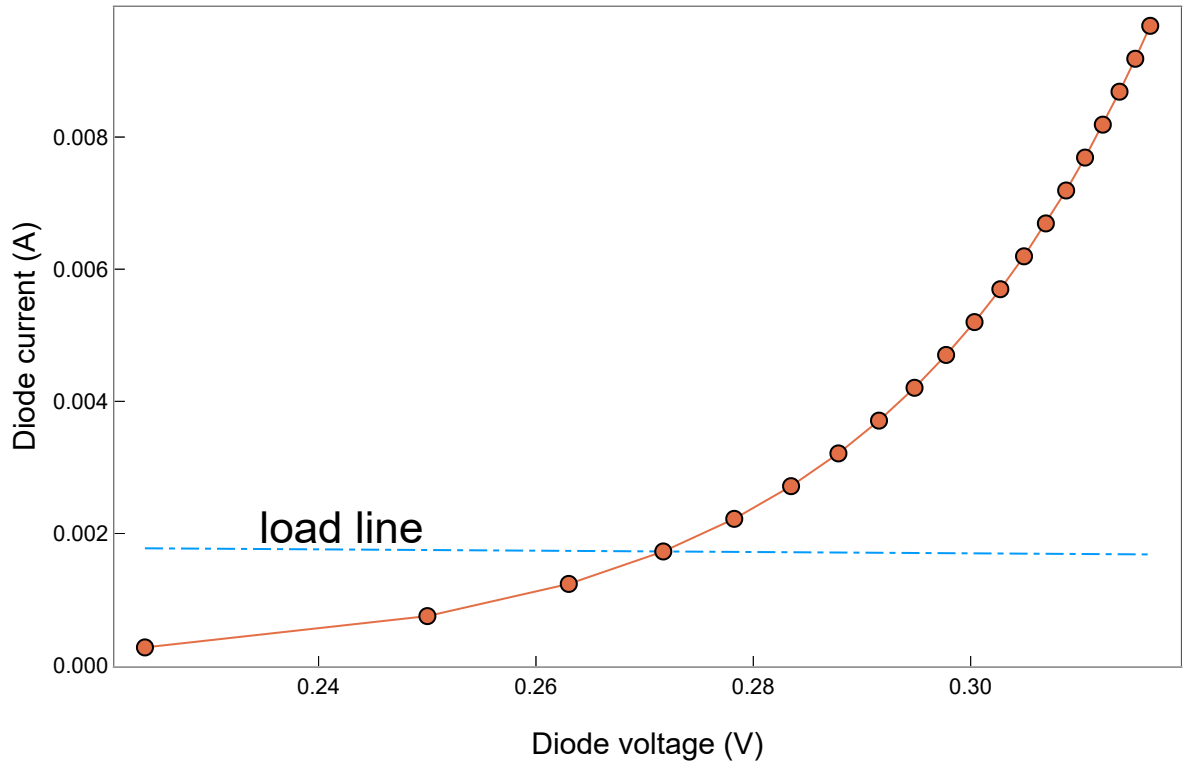
```
vz=deepcopy(VD);
iz=-(1/R)*(vz .- vdd);
```

In [10]:

```
plotlyjs();
plot(vz,iz,linestyle=:dashdot);
plot!(VD,ID,legend=false,grid=false,frame=:box,marker=true,xlabel="Diode voltage (V)", ylab
annotate!(0.25, 0.0021, text("load line", :black, :right, 16))
```

```
┌ Warning: ORCA.jl has been deprecated and all savefig functionality
│ has been implemented directly in PlotlyBase itself.
│
│ By implementing in PlotlyBase.jl, the savefig routines are automatically
│ available to PlotlyJS.jl also.
└ @ ORCA C:\Users\usmaa\.julia\packages\ORCA\U5XaN\src\ORCA.jl:8
```

Out[10]:



In [11]:

```
i=findall(iz - ID .<=1e-4)
println("Current value extracted from the intersection is: ",round(ID[i[1]]*1000,digits=3),
```

```
Current value extracted from the intersection is: 1.728 mA
```

Conclusion: Both methods give same value of circuit current for a particular v_{dd}