2014-09-24_lecture

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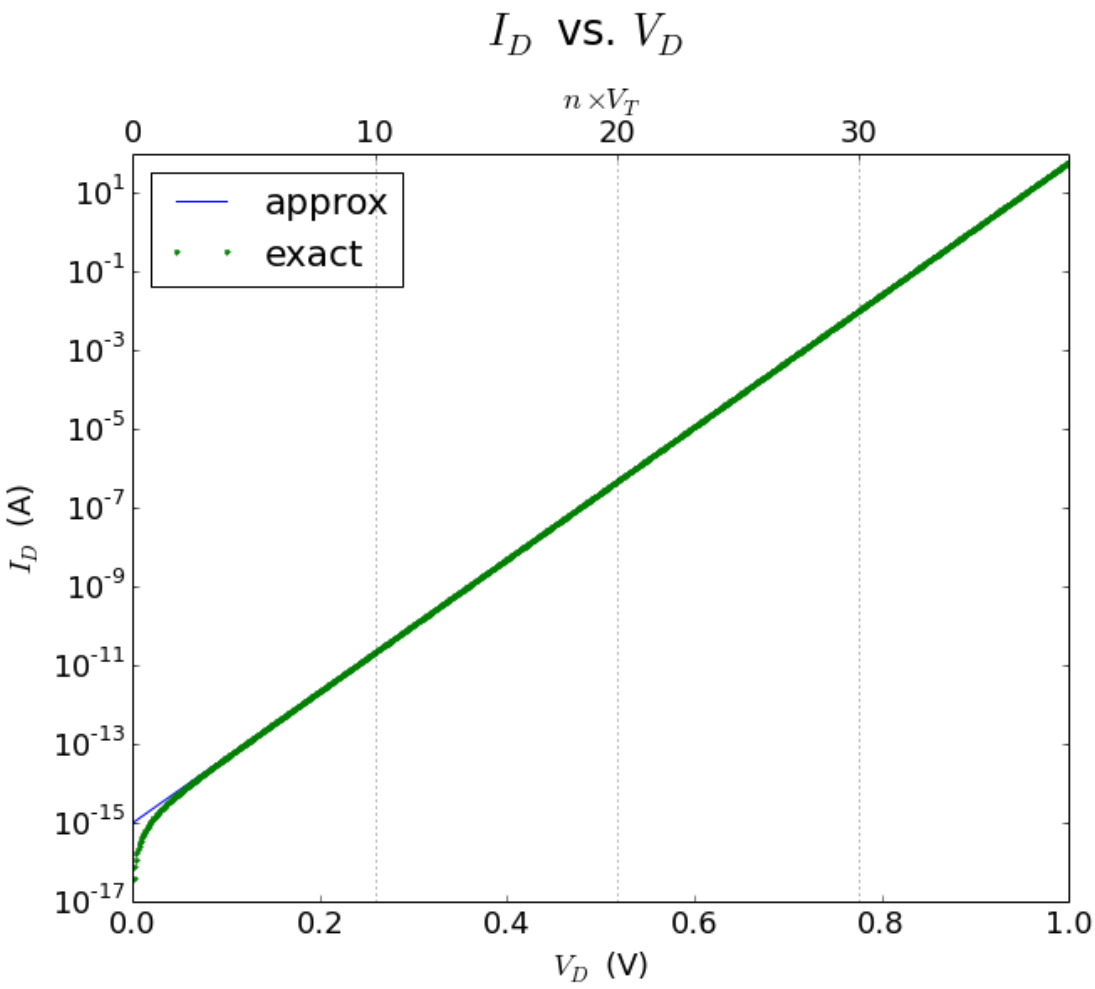
In [1]:
```
kB = 1.381e-23  # J/K
q = 1.602e-19  # C

def id(vd, Is=1e-15, T=300):
    VT = kB*T/q
    return Is*(exp(vd/VT) - 1)

def id_approx(vd, Is=1e-15, T=300):
    VT = kB*T/q
    return Is*exp(vd/VT)
```

In [15]:
```
v = linspace(1e-3, 1, 1e3)

def plot_idvd(v, nvt=5):
    ax1 = subplot()
    ax1.semilogy(v, id_approx(v), '-', label='approx')
    ax1.semilogy(v, id(v), '.', label='exact')
    ylabel('$I_D$ (A)')
    xlabel('$V_D$ (V)')
    suptitle('$I_D$ vs. $V_D$', y=1.05, size='x-large')
    legend(loc='best')
    r=xlim([0, v.max()])

    VT = kB*300/q
    ax2 = ax1.twiny()

    vts = arange(0, int(v.max()/VT)+1, nvt)
    print vts
    #ax2.semilogy(v, id(v)); ax2.cla()
    ax2.set_xticks(VT*vts)
    ax2.set_xticklabels(vts)
    ax2.set_xlabel(r'$n\times V_T$')
    ax2.grid(True)
    ax2.set_xlim(r)

plot_idvd(v, nvt=10)
```

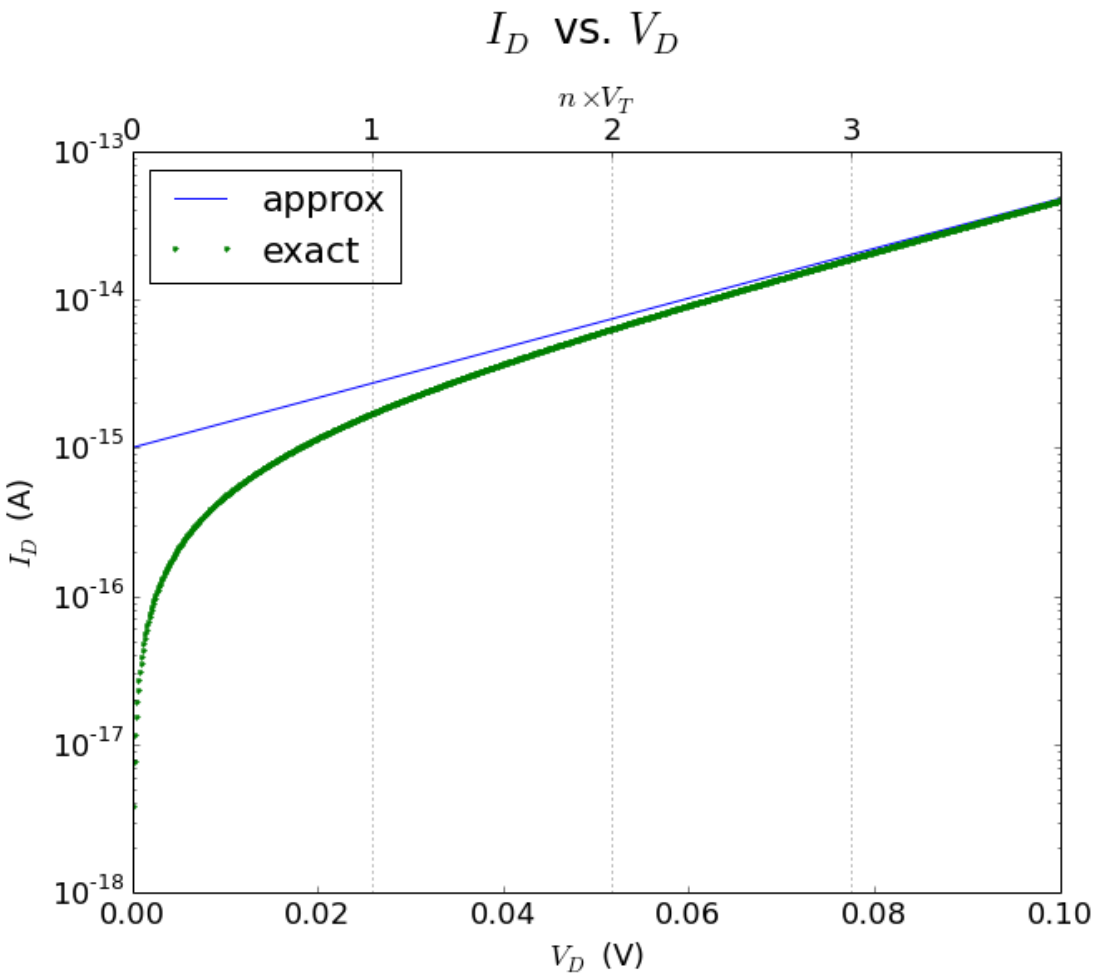
```
[ 0 10 20 30]
```



0.1 Zoom in to around $V_D = 0$

In [16]:
```
v = linspace(0, 0.1, 1e3)
plot_idvd(v, nvt=1)
```

```
[0 1 2 3]
```



In [5]:
```
title?
```

In [3]: