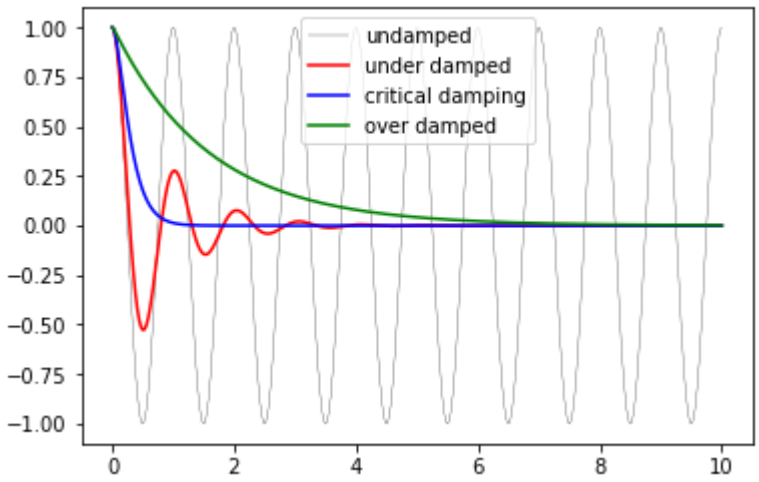
In [2]:

```
from numpy import linspace
from math import pi
from scipy.integrate import odeint
from matplotlib.pyplot import subplots

def dy(y, t, zeta, w0):
    """
    The right-hand side of the damped oscillator ODE
    """
    x, p = y[0], y[1]

    dx = p
    dp = -2 * zeta * w0 * p - w0**2 * x

    return [dx, dp]
# initial state:
y0 = [1.0, 0.0]
# time coordinate to solve the ODE for
t = linspace(0, 10, 1000)
w0 = 2*pi*1.0
# solve the ODE problem for three different values of the damping ratio
y1 = odeint(dy, y0, t, args=(0.0, w0)) # undamped
y2 = odeint(dy, y0, t, args=(0.2, w0)) # under damped
y3 = odeint(dy, y0, t, args=(1.0, w0)) # critial damping
y4 = odeint(dy, y0, t, args=(5.0, w0)) # over damped
fig, ax = subplots()
ax.plot(t, y1[:,0], 'k', label="undamped", linewidth=0.25)
ax.plot(t, y2[:,0], 'r', label="under damped")
ax.plot(t, y3[:,0], 'b', label=r"critical damping")
ax.plot(t, y4[:,0], 'g', label="over damped")
ax.legend();
```



In [ ]: