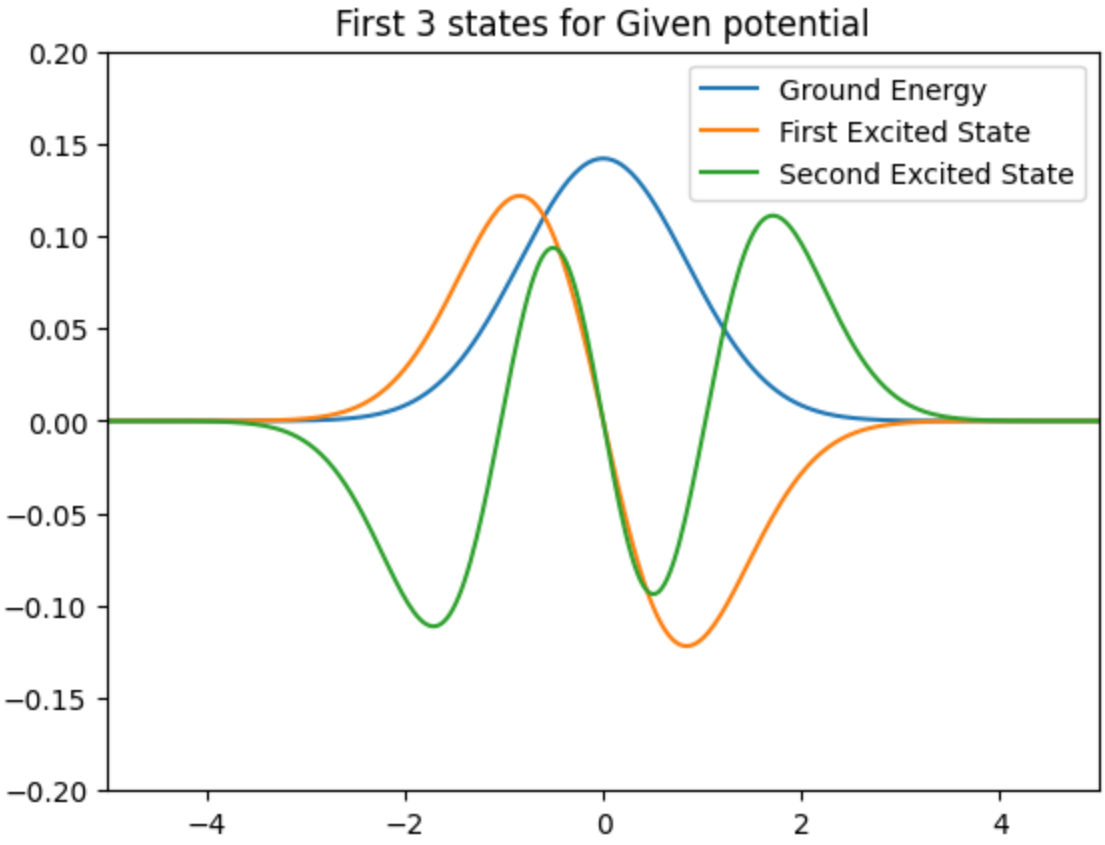
In [66]:
```
import matplotlib.pyplot as plt
import numpy as np
from scipy import linalg

L = 15
N = 500
dx = L/(N-1)
# Defining Kinetic Energy Matrix
H = ( np.diag(-2 * np.ones(N))) + np.diag(np.ones(N-1),k=1) + np.diag(np.ones(N-1),k=-1)
H =( -0.5 * H)/(dx**2)
# Defining Potential Matrix
def potential(x):
    return x ** 2


xs = dx * np.arange(N)-L/2
TE = H + np.diag(potential(xs), k=0)

w,v = linalg.eigh(TE)
plt.title("First 3 states for Given potential")
plt.plot(xs, v[:,0], label = "Ground Energy")
plt.plot(xs, v[:,1], label = "First Excited State")
plt.plot(xs, v[:,3], label = "Second Excited State")

ax = plt.gca()
ax.set_xlim([-5, 5])
ax.set_ylim([-0.2, 0.2])

plt.legend()
plt.show()

print("Ground state", w[0])
print("First Excited State" ,w[1])
print("Second excited state" , w[2])
```

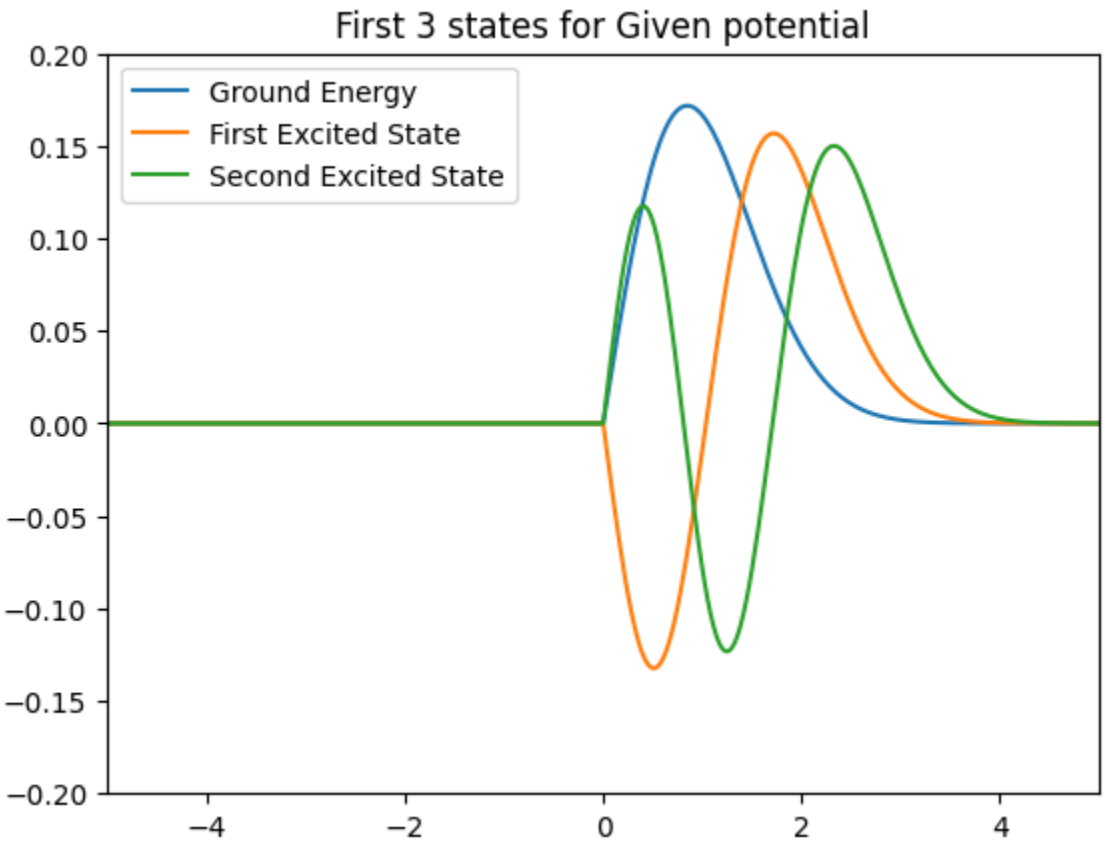



```
Ground state 0.7070503009979824
First Excited State 2.1210379245636237
```

```
Second excited state 3.5347995641721646
```

In [68]:

```
# Defining Kinetic Energy Matrix
H = ( np.diag(-2 * np.ones(N))) + np.diag(np.ones(N-1),k=1) + np.diag(np.ones(N-1),k=-1)
H =( -0.5 * H)/(dx**2)
# Defining Potential Matrix
def potential(x):
    return x**2

xs = dx * np.arange(N)
TE = H + np.diag(potential(xs), k=0)

w,v = linalg.eigh(TE)
ground = np.append(np.zeros(N), v[:,0])
first = np.append(np.zeros(N), v[:,1])
second = np.append(np.zeros(N), v[:,2])
xs = dx * np.arange(N * 2)-L

plt.title("First 3 states for Given potential")
plt.plot(xs, ground, label = "Ground Energy")
plt.plot(xs, first, label = "First Excited State")
plt.plot(xs, second, label = "Second Excited State")
ax = plt.gca()
ax.set_xlim([-5, 5])
ax.set_ylim([-0.2, 0.2])

plt.legend()
plt.show()
print("Ground state", w[0])
print("First Excited State" ,w[1])
print("Second excited state" , w[2])
```




```
Ground state 2.064705385000181
First Excited State 4.863520417744878
Second excited state 7.668552215998307
```

In [ ]: