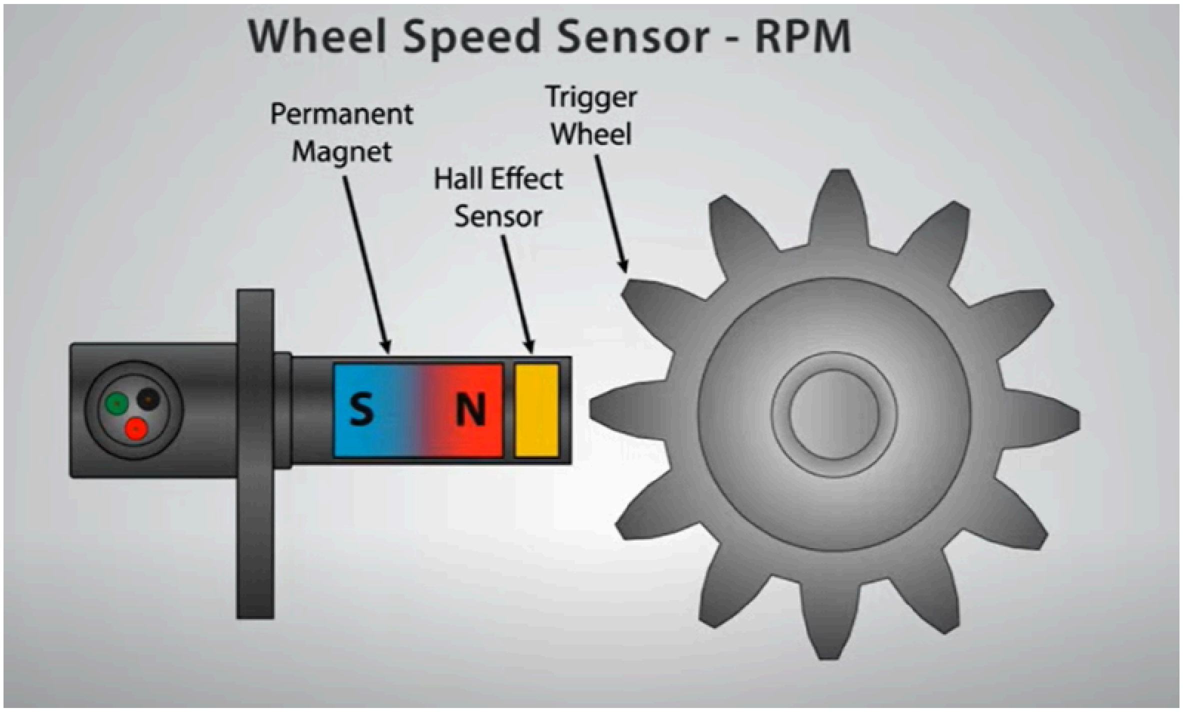
Special Topic Calculations: Hall Effect Sensors

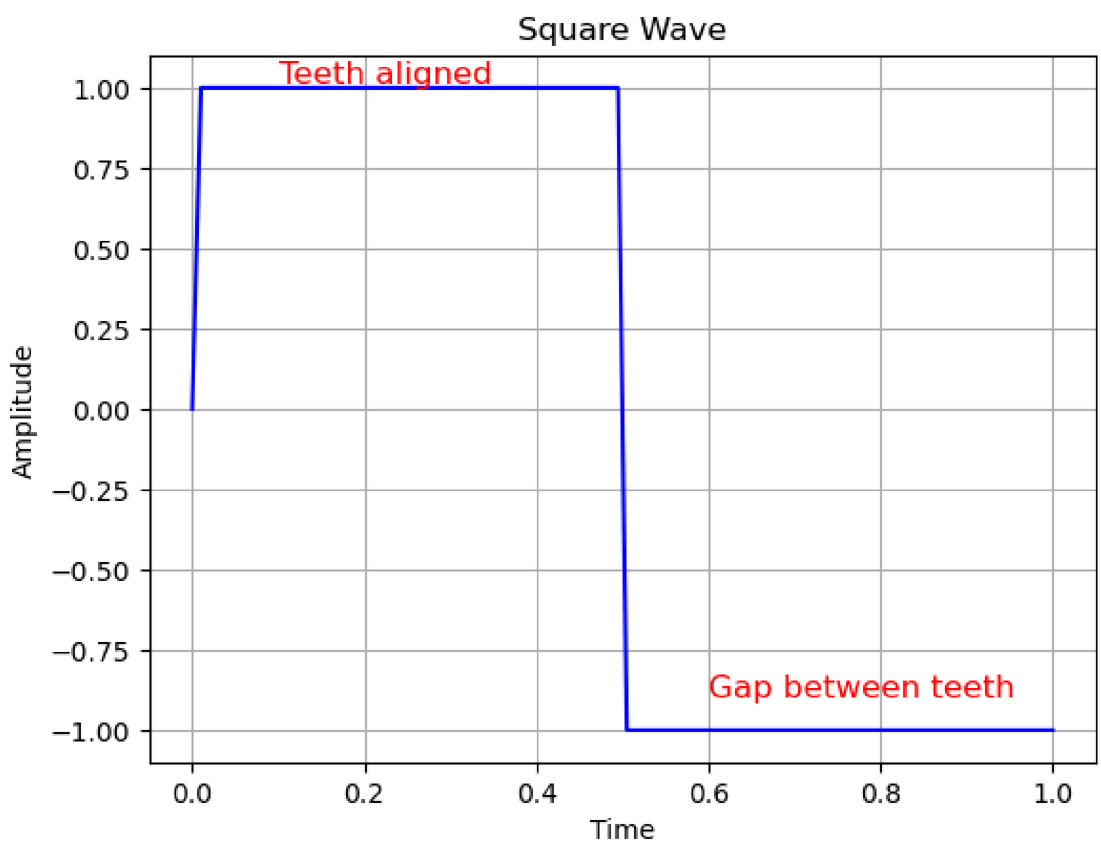


The wheel is made of some ferromagnetic material and place near a magnet with a Hall effect sensor inbetwen. As the wheel rotates, the total magentic field around the senor varies, reaching a peak when on of the wheel's teeth is aligned with the sensor (when the ferromagnet is closest) and reaching a trough in the gaps between the teeth (when it is furtherest). By ploting this variation in the magnetic field over time, we are able to measure the frequency or period and find the speed at which the wheel is spinning.

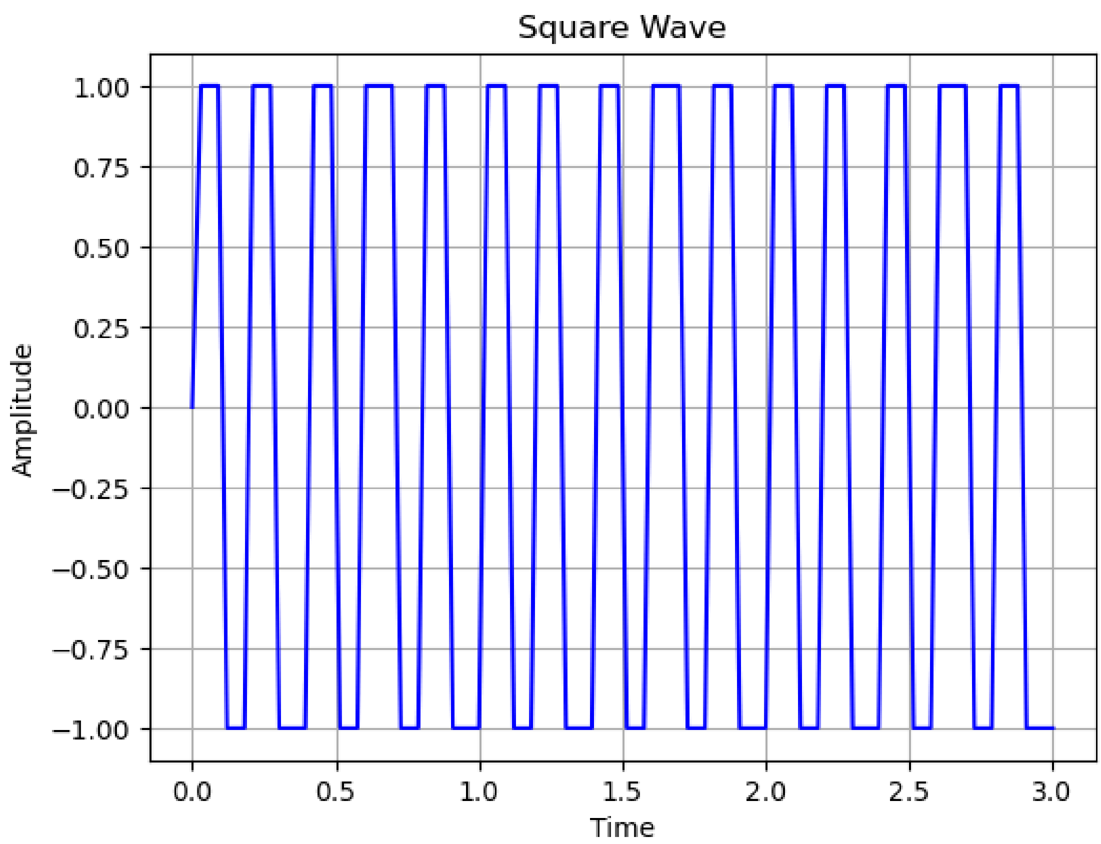
The plot could look something like below.

In [33]:

```
import numpy as np
import matplotlib.pyplot as plt

frequency = 1.0
amplitude = 1.0
n = 100

t = np.linspace(0, 1, n)

square_wave = amplitude * np.sign(np.sin(2 * np.pi * frequency * t))

plt.plot(t, square_wave, color='blue')
plt.title('Square Wave')
plt.xlabel('Time')
plt.ylabel('Amplitude')
plt.grid(True)

plt.text(0.1, 1.01, 'Teeth aligned', fontsize=12, color='red')
plt.text(0.6, -0.9, 'Gap between teeth', fontsize=12, color='red')

plt.show()
```



In [32]:
```
frequency = 5.0
amplitude = 1.0

n = 100

t = np.linspace(0, 3, n)

square_wave = amplitude * np.sign(np.sin(2 * np.pi * frequency * t))

plt.plot(t, square_wave, color='blue')
plt.title('Square Wave')
plt.xlabel('Time')
plt.ylabel('Amplitude')
plt.grid(True)

plt.show()
```



If we take the number of teeth from the picture above, we can see that we make one full rotation at around 2.25 s. This allows us to find the speed of the wheel's rotations like below.

In [36]:
```
omega = 2*np.pi/(2.25)
print(f'The wheel rotates at about {omega:.1f} radians per second')
```

```
The wheel rotates at about 2.8 radians per second
```

In [ ]:

```
```