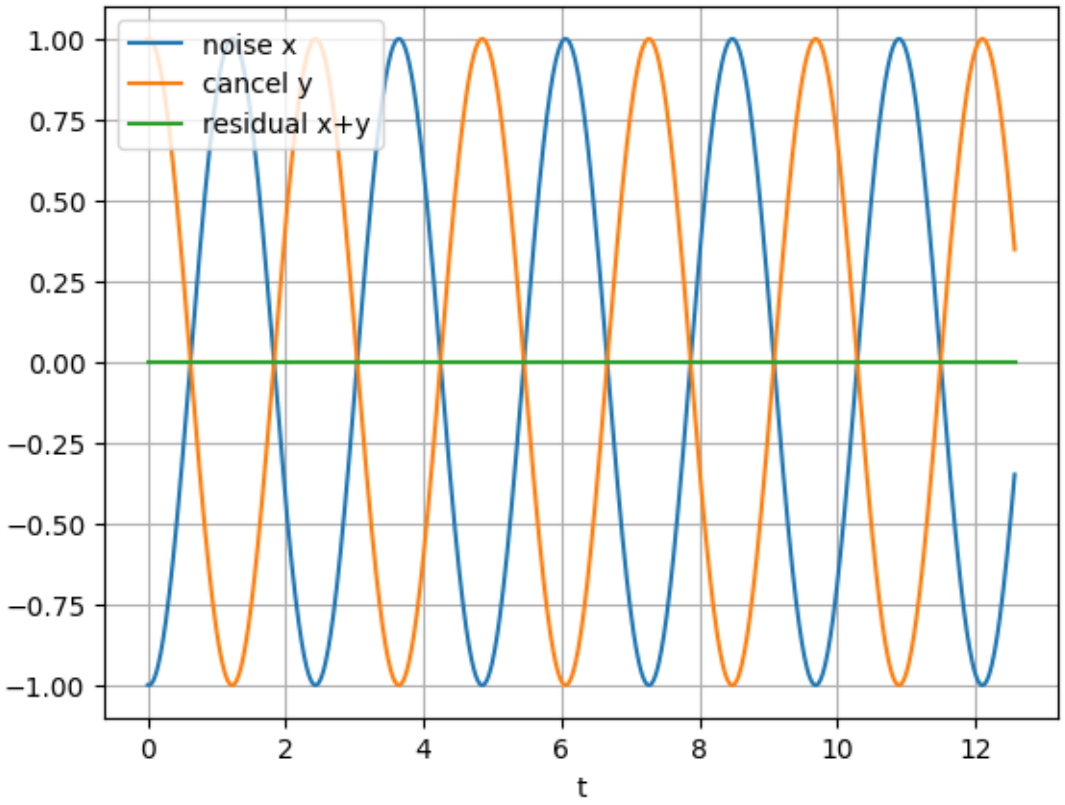
Homework3

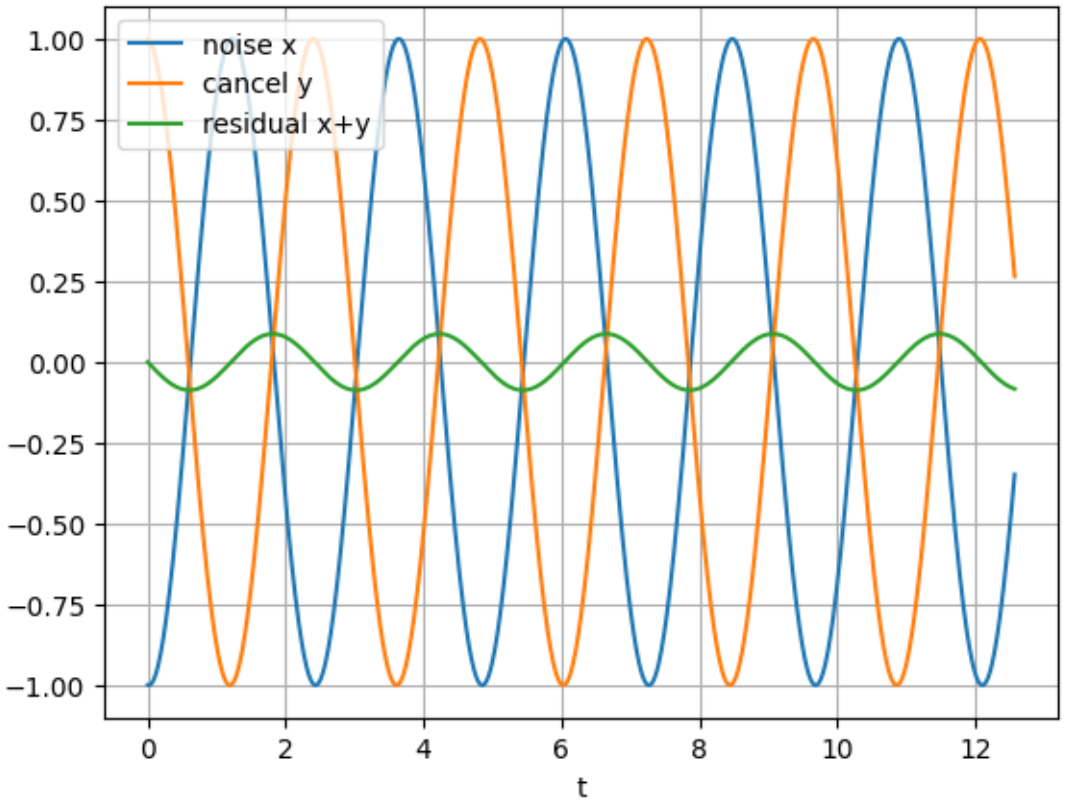
September 22, 2025

[27]:
```
import numpy as np
import matplotlib.pyplot as plt

N = 1000 # samples
om = 2.6 # angular frequency
phi = 3.1 # phase of the noise
A = 1.0 # noise amplitude
m = 0 # integer
t = np.linspace(0, 4*np.pi, N)

# Perfect cancellation parameters
phi_cancel = np.pi + phi + 2*np.pi*m
B = A

x = A*np.cos(om*t + phi) # noise
y = B*np.cos(om*t + phi_cancel) # canceller
r = x + y # residual

plt.plot(t, x, label="noise x")
plt.plot(t, y, label="cancel y")
plt.plot(t, r, label="residual x+y")
plt.legend(); plt.xlabel("t"); plt.grid(True)
plt.show()


""" Problem 1 Part d-1 """
```



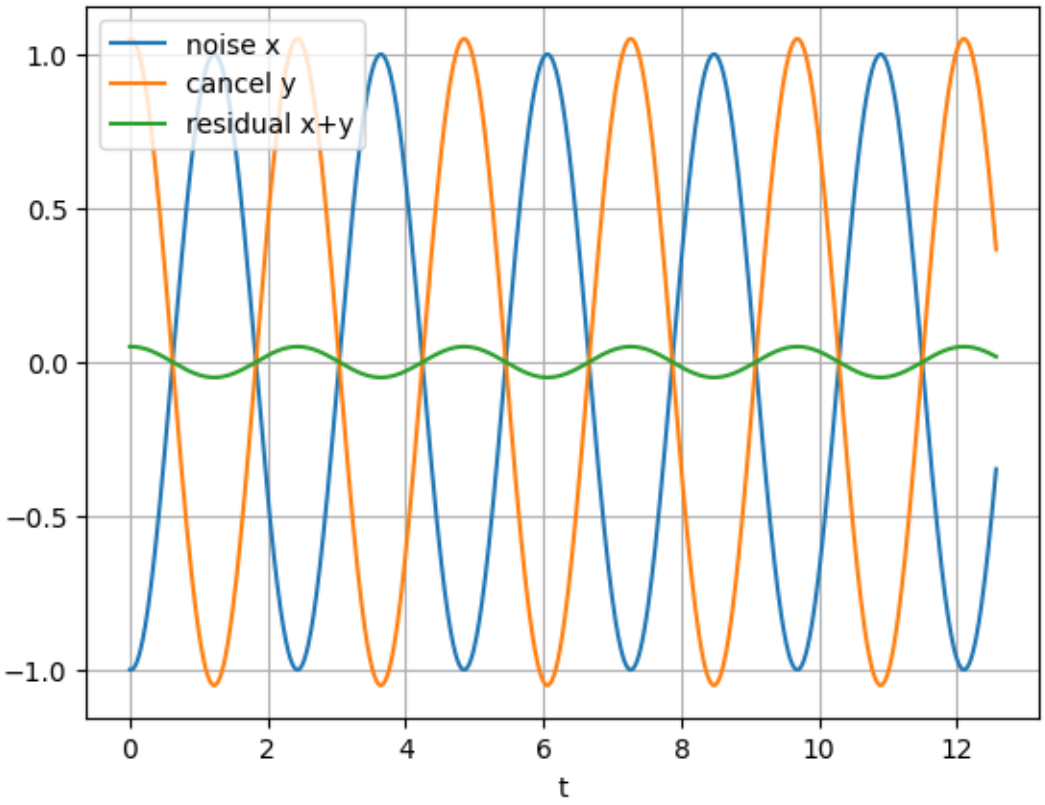
[27]:
```
' Problem 1 Part d-1 '
```

[28]:
```
# Phase Error cancellation parameters
phase_error = 5
phi_cancel = np.pi + phi + 2*np.pi*m + np.pi*phase_error/180
B = A

y_phase_error = B*np.cos(om*t + phi_cancel) # canceller
r_phase_error = x + y_phase_error # residual

plt.plot(t, x, label="noise x")
plt.plot(t, y_phase_error, label="cancel y")
plt.plot(t, r_phase_error, label="residual x+y")
plt.legend(); plt.xlabel("t"); plt.grid(True)
plt.show()


""" Problem 1 Part d-2 Phase Error """
```



[28]:
```
' Problem 1 Part d-2 Phase Error '
```

[29]:
```
# Amplitude Error cancellation parameters
amp_error = 0.05
phi_cancel = np.pi + phi + 2*np.pi*m
B = A*(1+amp_error)

y_amp_error = B*np.cos(om*t + phi_cancel) # canceller
r_amp_error = x + y_amp_error # residual

plt.plot(t, x, label="noise x")
plt.plot(t, y_amp_error, label="cancel y")
plt.plot(t, r_amp_error, label="residual x+y")
plt.legend(); plt.xlabel("t"); plt.grid(True)
plt.show()


""" Problem 1 Part d-2 Amplitude Error """
```



[29]: ' Problem 1 Part d-2 Amplitude Error '

[30]:
```
def RMS(x):
    sum = 0
    for val in x:
        sum += val**2
    MS = sum/len(x)
    return np.sqrt(MS)

print(f"The RMS value of the Phase error Residual is:␣
 ↪{round(RMS(r_phase_error),5)}")
print(f"The RMS value of the Amplitude error Residual is:␣
 ↪{round(RMS(r_amp_error),5)}")


""" Problem 1 Part d-3 """
```

```
The RMS value of the Phase error Residual is: 0.06141
The RMS value of the Amplitude error Residual is: 0.03556
```

[30]: ' Problem 1 Part d-3 '