A_2_answer

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Bioinstrumentation ENGG 6150 Assignment
Student: Jian Bin(Kevin), Lin
Instructor: Dr.Maher Bakri-Kassem

Q1:

$R_a = R_d = R_o$ - Z * $R_o = R_o(1 - Z)$

$R_o = \frac{R_a}{1-Z}$

$R_b = R_C = R_o = \frac{R_a}{1-Z} = \frac{R_d}{1-Z}$

Output voltage has positive and negative output.

$\frac{v_{O+}}{V_{ps}} = \frac{R_a}{R_a+R_b}$

This is because positive voltage connects to R_b and R_a

Arrange formula

$V_{O+} = \frac{V_{ps}R_o(1-Z)}{R_o(1-Z)+R_o}$

R_o cancelled out from denominator and numerinator

$V_{O+} = \frac{V_{ps}(1-Z)}{(1-Z)+1}$

$V_{O+} = \frac{V_{ps}(1-Z)}{2-Z}$

same principle apply to negative voltage side as it connects to R_c and R_d

$\frac{v_{O-}}{V_{ps}} = \frac{R_d}{R_c+R_d}$

Arrange formula

$V_{O-} = \frac{V_{ps}R_o(1-Z)}{R_o(1-Z)+R_o}$

R_o cancelled out from denominator and numerinator

$V_{O-} = \frac{V_{ps}(1-Z)}{(1-Z)+1}$

$V_{O-} = \frac{V_{ps}(1-Z)}{2-Z}$

$V_o = V_{O+} + V_{O-}$

since negative node is "-", therefore

$V_o = \frac{V_{ps}(1-Z)}{2-Z}$ - $\frac{V_{ps}(1-Z)}{2-Z} = 0$

Output voltage does not depend on Z.

Alternatively, we can swab R_a with R_b or R_c with R_d.

Assume swab R_a with R_b Then

$\frac{v_{O+}}{V_{ps}} = \frac{R_b}{R_a+R_b}$

Arrange formula

$V_{O+} = \frac{V_{ps}R_o}{R_o(1-Z)+R_o}$

R_o cancelled out from denominator and numerinator

$V_{O+} = \frac{V_{ps}(1)}{(1-Z)+1}$

$V_{O+} = \frac{V_{ps}(1)}{2-Z}$

$\frac{v_{O-}}{V_{ps}} = \frac{R_d}{R_c+R_d}$

Arrange formula

$V_{O-} = \frac{V_{ps}R_o(1-Z)}{R_o(1-Z)+R_o}$

R_o cancelled out from denominator and numerinator

$V_{O-} = \frac{V_{ps}(1-Z)}{(1-Z)+1}$

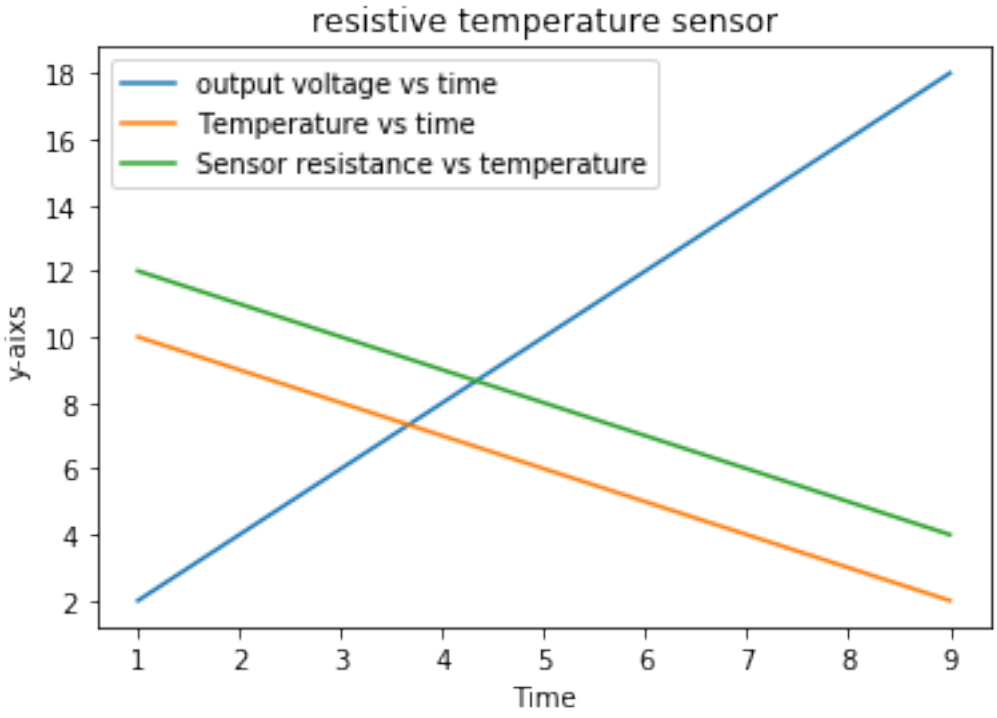
$V_{O-} = \frac{V_{ps}(1-Z)}{2-Z}$

$V_o = \frac{V_{ps}(1)}{2-Z}$ - $\frac{V_{ps}(1-Z)}{2-Z}$

Now output voltage depends on parameter Z.

In [36]:
```
import numpy as np
import math
import matplotlib.pyplot as plt
#Assume outage, temperature are certain values, question tells us that
#temperature is inversely proportional to time and resistive is inversely
#propotional to temperature

V_out = range(2,20,2)

Time = range(1,10)

Temperature = range(10,1,-1)

Resistance = range(12,3,-1)

plt.plot(Time,V_out,label='output voltage vs time')
plt.xlabel('Time')
plt.ylabel('y-aixs')
plt.title('resistive temperature sensor')

plt.plot(Time,Temperature,label='Temperature vs time')

plt.plot(Time,Resistance,label='Sensor resistance vs temperature')

plt.legend()
```

Out[36]: <matplotlib.legend.Legend at 0x11422bc88>



In [ ]: Q3:

ECG: Refers to ElectroCardioGram which is used to measure heart eletronic potential.Place electrode on the surface of human body. When muscle contracts,it creates action potential,ECG machine shows potential differece.

EEG: Refers to ElectroEncephaloGram which is used to electrical activity in brain.Electrical discs are attached to brain. When brain cells communicate with each other,it generates electrical potential which can be scanned using EEG.

EMG: Refers to ElectroMyoGraphy which is used to measure muscle electron response base on muscle nerve cell response. When muscle is at rest, there is no potential activity going on.These nerve cells are called motor neurons. They transfer electrical signals and ask muscle to relax or contract.

ENG: Refers to ElectroNystagmoGraphy which is used to detect false sense of spinning or motiion. Electrode has placed under or above the eye. The activity of eye motion has been recording in the machine. The electrical acivitiy that controls eye moverment have been recorded.

ERG:Refers to ElectroRetinoGraphy which is used to detect the function of retina. During the test, eye was forced to look at certain objects. Retina transmit the electrical signal which can be captured by the machine and generate voltage.