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# Unit 1: Frequency Response of Passive Networks

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**Linear Electronics II**

# Topics of Discussion

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**Review of logarithms and decibels.**

**General frequency response of passive networks.**

**Gain and phase calculations.**

**Bode plots.**

# The Decibel

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**The decibel is a common form of expressing input/output voltage relationships.**

**The basis for the decibel unit stems from the logarithmic response of the human ear to the frequency of sound.**

# The Decibel

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power gain is expressed in decibels by the formula:

$$A_{p(dB)} = 10 \log ( P_{out} / P_{in} )$$

voltage gain is expressed in decibels by the formula:

$$A_{v(dB)} = 20 \log ( V_{out} / V_{in} )$$

# Decibel Measurements

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A decibel measurement is always a **relative** measurement, measured with respect to some set input level.

The 'dBm' unit of power measurement is found by calculating the power gain in decibels by referencing to 1mW of power.

# Decibel Measurements

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**halving the output voltage for a steady input voltage is a 6dB reduction in gain :**

$$20\log(0.5) = -6\text{dB}$$

**halving the power output for a steady power input is a 3dB reduction in gain :**

$$10\log(0.5) = -3\text{dB}$$

# Frequency Response of Passive Networks

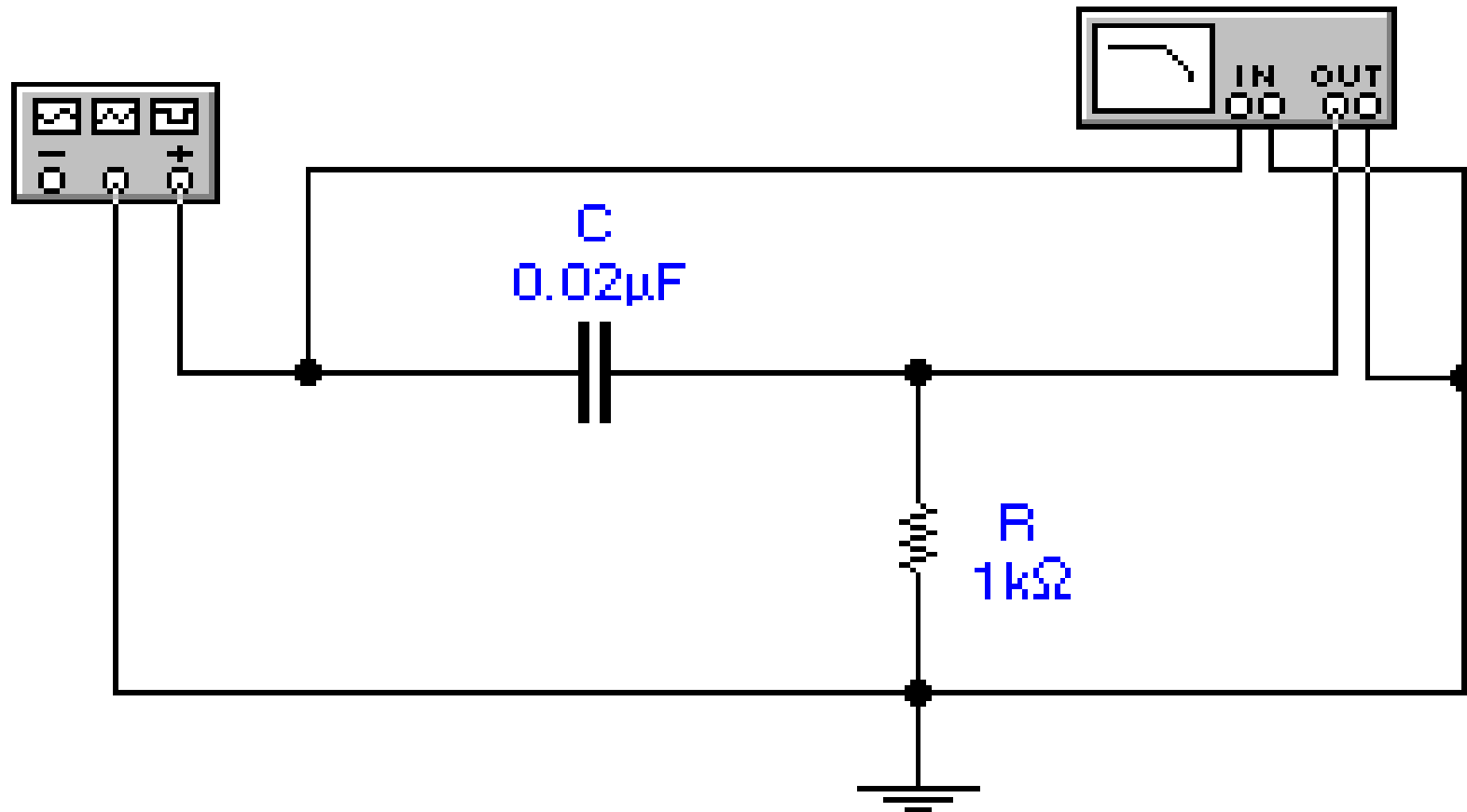
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**Based on concepts developed in previous courses, deduce which of the following 3 circuits would be considered a:**

- low pass RC filter**
- high pass RC filter**
- band pass RC filter**

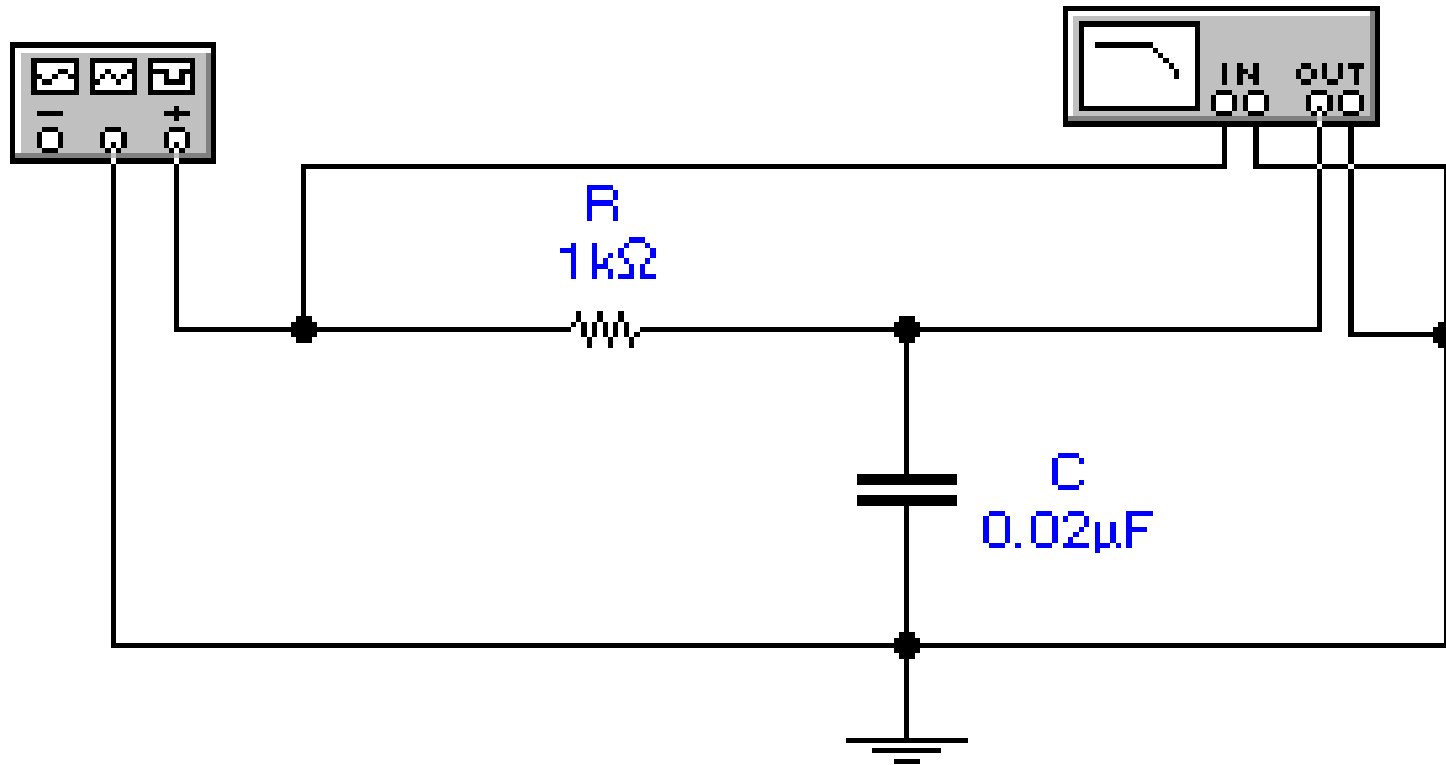
# Circuit 1

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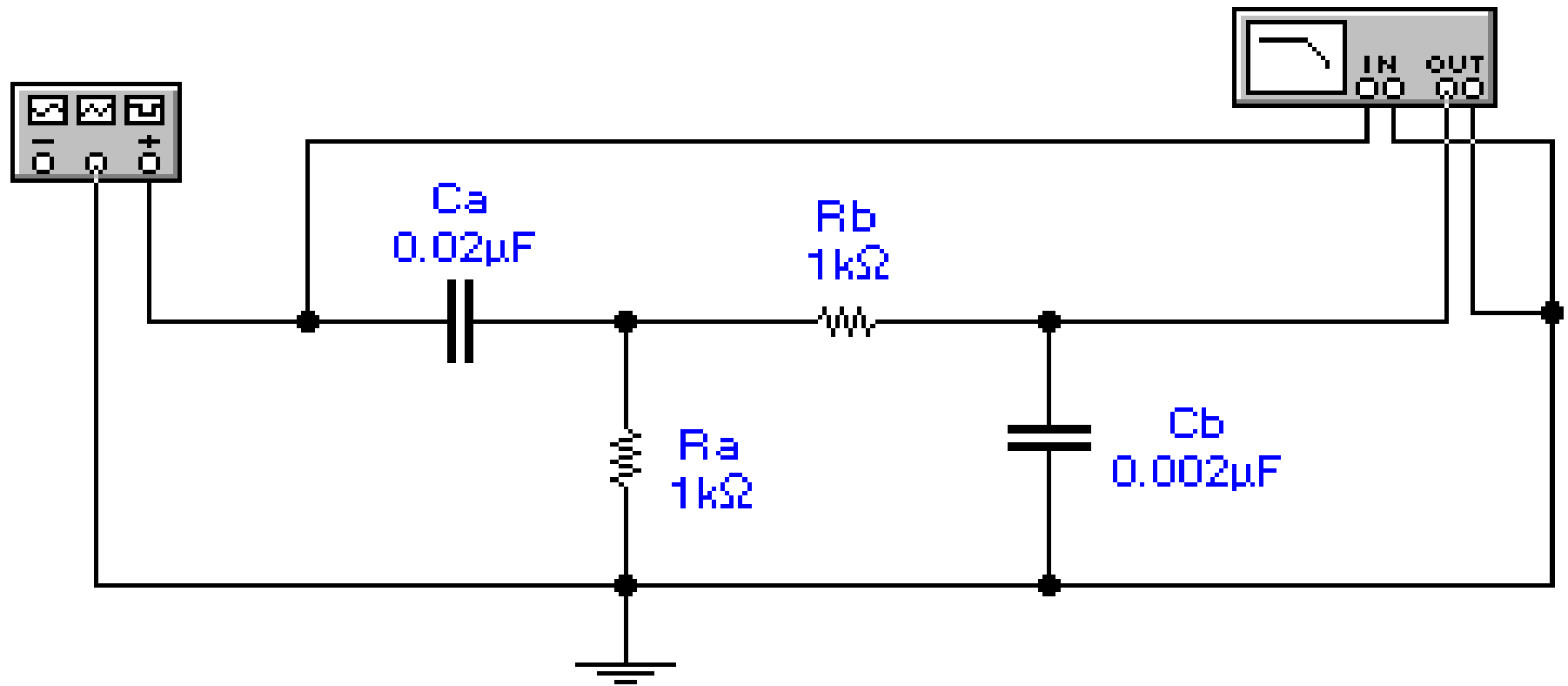


# Circuit 2

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# Circuit 3



# Gain and Phase Calculations

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Let us look at the low pass filter and analyze it's operation using circuit analysis techniques.

After analysis, let us look at the gain and phase results on the Bode plotter using Multisim.

- gain
- corner frequency
- roll-off
- phase shift

# The End

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## Read

→ Coughlin & Driscoll, chapters 1 and 2

## HW

→ Verify corner frequency, phase shift, and roll-off for circuit investigated in class by  
(1) calculation using formulas - let Mathcad or Excel do the work, and  
(2) testing the circuit using Multisim.  
Compare results.