

### Practice Problems for the Final Examination

**COURSE** : ECS204 Basic Electrical Engineering Laboratory

**INSTRUCTOR**: Asst. Prof. Dr. Prapun Suksompong

**PLACE** : BKD 3502

Name		ID	
Time	<input type="checkbox"/> group a: 9:30 – 10:30 AM <input type="checkbox"/> group b: 10:40 – 11:40 AM <input type="checkbox"/> group c: 1:30 – 2:30 PM <input type="checkbox"/> group d: 2:40 – 3:40 PM	Bench#	

#### Instructions:

1. This document contains **practice problems for the final examination**.
2. Date of the actual exam: **December 4, 2015**.
3. **Read these instructions and the questions carefully.**
4. Closed book. Closed notes. **No calculator.**
5. You may use any equipment available on your workbench to solve your questions or verify your answers.
6. For this practice session, you do not need any TA signature. However, for the actual exam, for the problems that ask for TA's signatures, lack of the signature(s) means no credit for the whole part. Request the TA to sign you answer again if you decide to change your answer later.
7. Allocate your time wisely. Some easy questions give many points.
8. When not explicitly stated/defined, all notations and definitions follow ones given in the lab manuals and slides.
9. **Units** are important.
10. When possible, record *at least two decimal places* from the DMM. Do not write 12 mA when you see 12.00 mA on the DMM's display.
11. On the actual exam, do not forget to write your **first name and the last three digits of your ID** on each page of your examination paper, starting from page 2.
12. For the actual exam,
  - a. the TAs will not help you debug your circuit.
  - b. arrive 10 minutes early; no restroom
  - c. do not leave the exam room until the end of the allotted time.
13. Do not cheat. The use of communication devices including mobile phones is prohibited in the examination room.
14. Organize items on your desk/bench before you leave the exam room.
15. Do not panic.

Sec 4		Sec 5	
5622770329	b	5622770261	d
5622770436	b	5622770741	c
5622770766	a	5622772648	c
5622771707	a	5622780120	d
5622772341	a	5622780195	d
5622772382	a	5622780625	c
5622772424	b	5622781250	c
5622780179	a	5622781334	d
5622780864	a	5622790814	c
5622781102	b	5622790830	d
5622781185	a	5622790954	d
5622781409	b	5622791135	c
5622781524	b	5622791374	d
5622781607	a	5622792034	d
5622781797	b	5622793081	d
5622781839	b	5622793123	c
5622791119	a	5622793206	c
5622791218	a	5622793354	d
5622791440	a	5622794493	c
5622791937	a	5622794972	d
5622792372	a	5622795616	c
5622793370	b	5622795632	c
5622793628	b	5622795715	c
5622794659	b		
5622795350	b		

### Basic Information

The following table might be useful for reading resistor code:

Black	Brown	Red	Orange	Yellow	Green	Blue	Violet	Grey	White
0	1	2	3	4	5	6	7	8	9

The pin details of op amp 741 are shown in Figure 1 below.

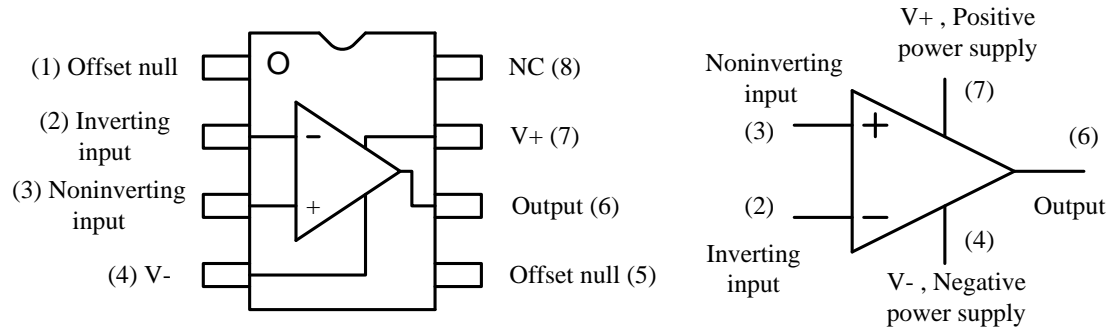


Figure 1

### Reminders:

1.  $V_{DC}$  = measured voltage value using the DMM in DC mode.
2.  $V_{AC}$  = measured voltage value using the DMM in AC mode.
3.  $V_{RMS} = \sqrt{v^2(t)} = \sqrt{\frac{1}{T} \int_{t_0}^{t_0+T} v^2(t) dt}$  for periodic waveform  $v(t)$  with period  $T$

Name \_\_\_\_\_ ID \_\_\_\_\_

Model number of your DMM: \_\_\_\_\_

Model number of your Oscilloscope: \_\_\_\_\_

### Problem 0

Display the calibration signal of the oscilloscope on both channel 1 and channel 2 of the oscilloscope. The ground levels of both channels should be in the middle of the screen.

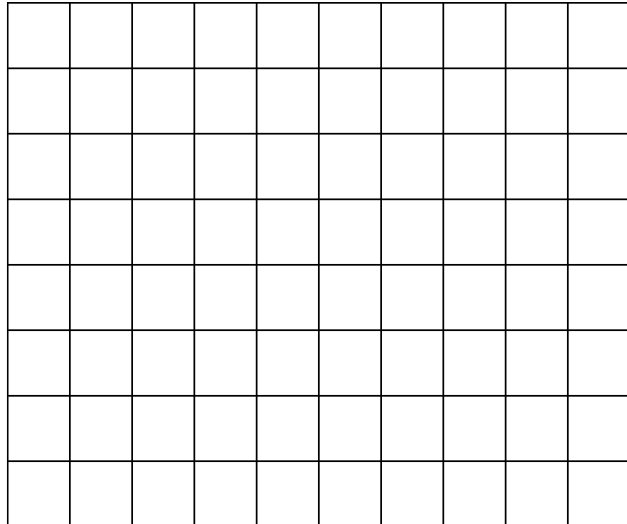
### Problem 1

Use the function generator to generate a 3 V<sub>p-p</sub> 2 kHz **square** waveform. Set the **DC offset** of the waveform to be 1 V. Display the waveform on channel 1 of the oscilloscope. Make sure that the scope is in **DC mode**.

Sketch the waveforms here. Indicate the ground level on your sketch as well.

Voltage/Division \_\_\_\_\_

Time/Division \_\_\_\_\_



**Measure** V<sub>DC</sub> and V<sub>AC</sub> of this waveform.

V<sub>DC</sub> = \_\_\_\_\_

V<sub>AC</sub> = \_\_\_\_\_

Now, **change** the DC offset to 2 V.

**Measure** V<sub>DC</sub> and V<sub>AC</sub> of this waveform.

V<sub>DC</sub> = \_\_\_\_\_

V<sub>AC</sub> = \_\_\_\_\_

**Problem 2**

Connect the circuit as shown in Figure 2.

Use  $R_1 = 1\text{ k}\Omega$   
and  $R_2 = 2\text{ k}\Omega$ .

Measure the exact values of the resistance for  $R_1$  and  $R_2$ .

Record these values in the table here along with the corresponding color codes.

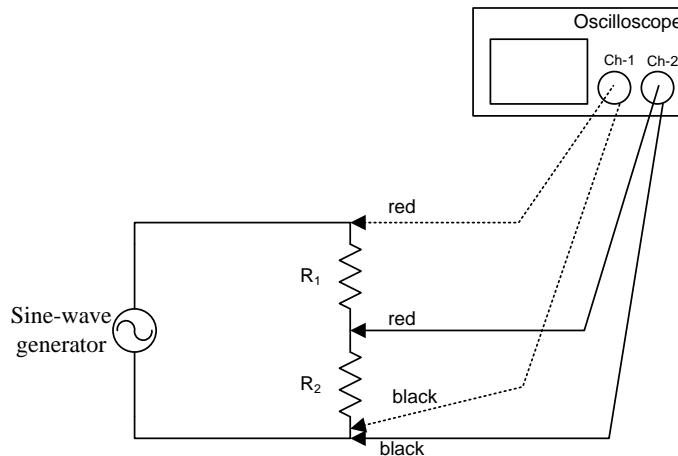


Figure 2

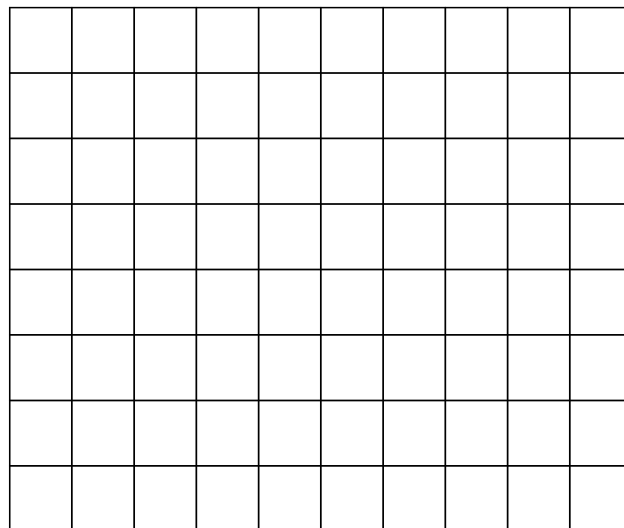
	Value	Color Code
$R_1$		
$R_2$		

Set the function generator to generate a  $2\text{ V}_{p-p}$  1 kHz **sinusoidal** waveform with **NO DC offset**.

a) Sketch the waveforms here. Make sure that you put appropriate labels (“Ch-1” or “Ch-2”) on your sketch. Indicate the ground level on your sketch as well.

Voltage/Division \_\_\_\_\_

Time/Division \_\_\_\_\_



b) From the oscilloscope display, read the peak-to-peak voltage  $V_1$  across  $R_1$ , and the peak-to-peak voltage  $V_2$  across  $R_2$ .

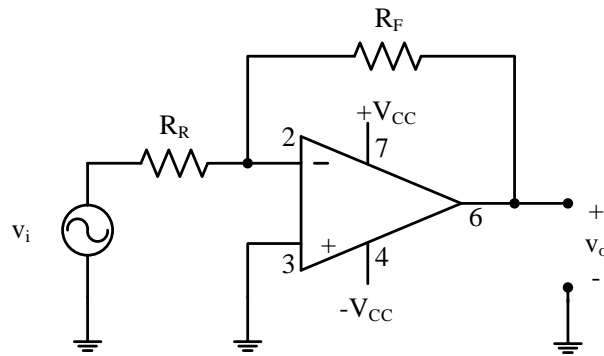
$V_1$  (p-p) = \_\_\_\_\_  $V_2$  (p-p) = \_\_\_\_\_

c) Measure the rms current  $I_1$  through the resistor  $R_1$ .

$I_1$  (rms) = \_\_\_\_\_

### Problem 3

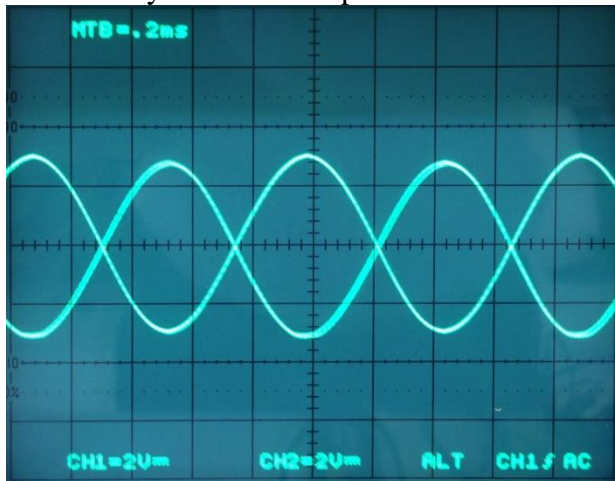
Connect the circuit in the figure below. Channel 1 of the oscilloscope should display  $v_i$  and Channel 2 of the oscilloscope should display  $v_o$ .



a. Select

- the resistance values  $R_F$  and  $R_R$  (which can be 5-k $\Omega$ , 10-k $\Omega$ , or 20-k $\Omega$ )
- the signal shape, amplitude, and frequency of the signal from the function generator
- the values of  $V_{CC}$  from the power supply
- the settings on the oscilloscope panel

so that your oscilloscope screen matches the photo below.

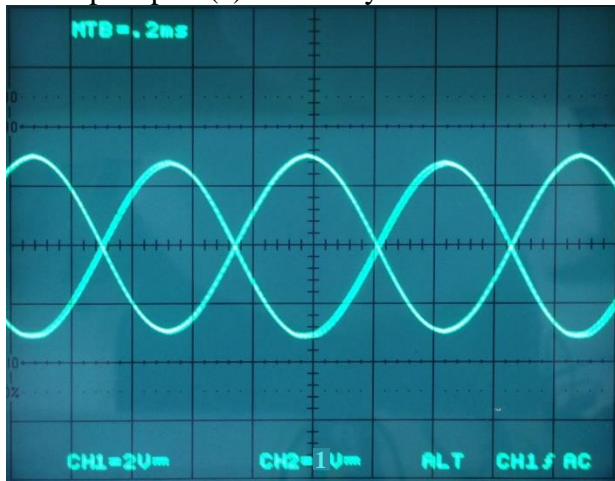


$R_F =$  \_\_\_\_\_

$R_R =$  \_\_\_\_\_

$f =$  \_\_\_\_\_

b. Repeat part (a) but now your screen should match the new photo below.



$R_F =$  \_\_\_\_\_

$R_R =$  \_\_\_\_\_

$f =$  \_\_\_\_\_

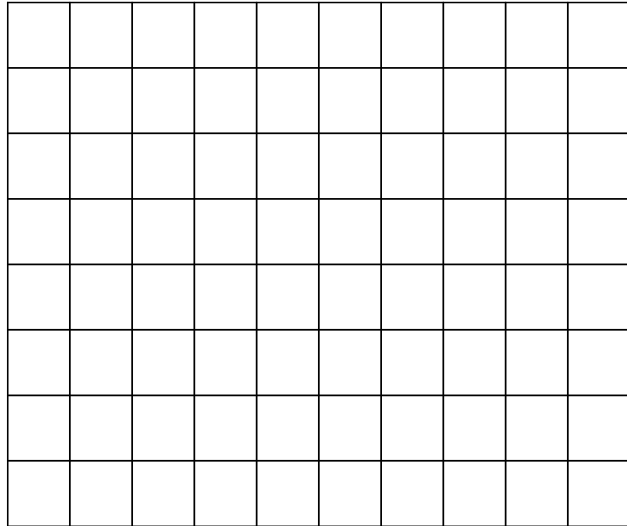
**Problem 4**

a) Use the function generator to generate a  $1\text{ V}_{\text{rms}}$  2 kHz **sinusoidal** waveform with **NO DC offset**. Display it on channel 1 of the oscilloscope. Make sure that the scope is in DC mode.

Sketch the waveform here. Indicate the ground level on your sketch as well.

Voltage/Division \_\_\_\_\_

Time/Division \_\_\_\_\_



Record the exact rms value here: \_\_\_\_\_

Record the exact frequency here: \_\_\_\_\_

Find the peak-to-peak value of this signal: \_\_\_\_\_

For the rest of this problem, **DO NOT** adjust anything on the function generator. This means keep its OPEN-circuit voltage at  $1\text{ V}_{\text{rms}}$ .

b) Connect the function generator output (with  $1\text{ V}_{\text{rms}}$  OPEN-circuit voltage) across a  $100\Omega$  resistor. Measure the voltage (rms) across this resistor.

The exact resistance is \_\_\_\_\_.

The rms voltage across the resistor is \_\_\_\_\_. (Hint: Not 1.)

Display the voltage across the resistor on channel 1 of the oscilloscope. Make sure that the scope is in DC mode. Sketch the waveforms here. Indicate the ground level on your sketch as well.


Voltage/Division \_\_\_\_\_

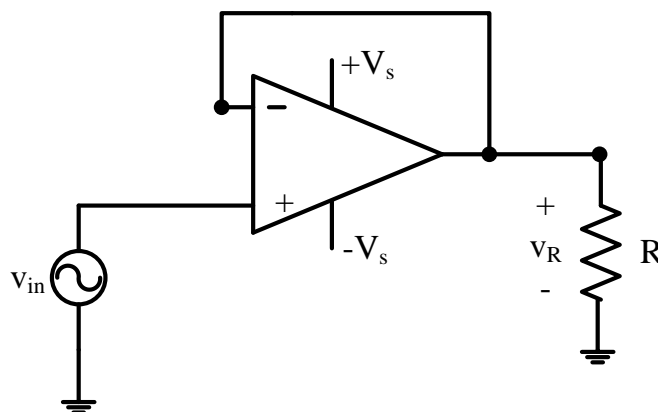
Time/Division \_\_\_\_\_

c) Change the resistor to  $50\Omega$ . (If you can't find a  $50\Omega$  resistor, you can construct one using two  $100\Omega$  resistors.) Measure the voltage (rms) across this resistor.

The exact resistance is \_\_\_\_\_.

The rms voltage across the resistor is \_\_\_\_\_. (Hint: Not 1.)

d) Connect the circuit as shown in the figure below:



Use  $V_S = 10\text{ V}$ . The input  $v_{in}$  is again the  $2\text{ kHz}$  sinusoidal waveform with  $1\text{ V}_{rms}$  OPEN-circuit voltage from the function generator. Measure the rms voltage across  $R$  when  $R$  is  $100\Omega$ .

The exact resistance is \_\_\_\_\_.

The rms voltage across the resistor is \_\_\_\_\_.

e) Change the resistor to  $50\Omega$ . Measure the voltage (rms) across this resistor.

The exact resistance is \_\_\_\_\_.

The rms voltage across the resistor is \_\_\_\_\_.

f) Why does the voltages across the resistor change when there is no op amp?

**Problem 5**

a) Connect the circuit as shown in Figure 3. Adjust the function generator to generate a  $2 V_{p-p}$  2 kHz **sinusoidal** waveform with **NO DC offset**. Use  $R = 3.3 k\Omega$ .

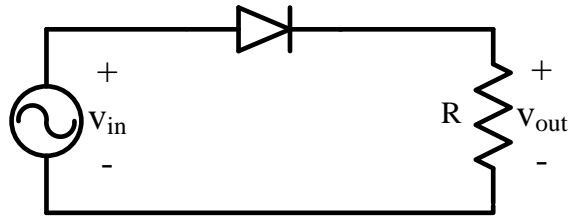


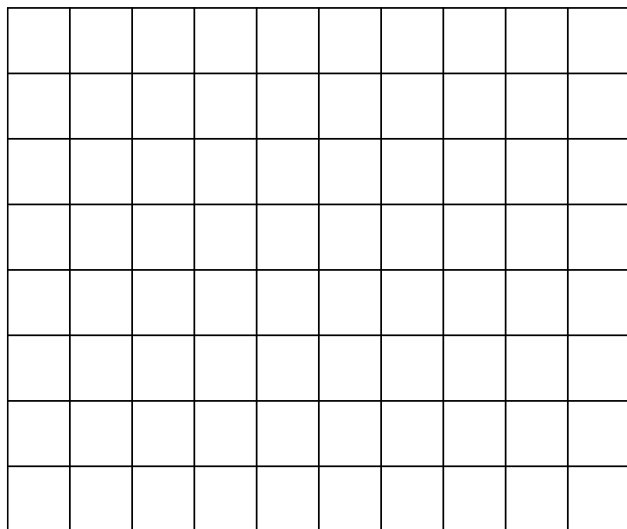
Figure 3

The exact value of R is \_\_\_\_\_.

Display the voltage  $v_{in}$  across the function generator on channel 1 of the oscilloscope. Display the voltage  $v_{out}$  across the resistor R on channel 2 of the oscilloscope. Make sure that the scope is in DC mode. Sketch the waveforms here. Make sure that you put appropriate labels (“Ch-1” or “Ch-2”) on your sketch. Indicate the ground level on your sketch as well.

Voltage/Division \_\_\_\_\_

Time/Division \_\_\_\_\_



b) Describe the relationship between  $v_{in}$  and  $v_{out}$ .

c) Measure the peak-to-peak,  $V_{AC}$ , and DC (average) values of  $v_{in}$  and  $v_{out}$ .

	$V_{peak-to-peak}$	$V_{AC}$	$V_{DC}$
$V_{in}$			
$V_{out}$			