國立東華大學

Department of Physics
National Dong Hwa University, 1, Sec. 2,
Da Hsueh Rd., Shoufeng, Hualien, 974, Taiwan

General Physics I, Final 2
PHYS10400, Class year 103
06-25-2015

SN:_____, Name:_____

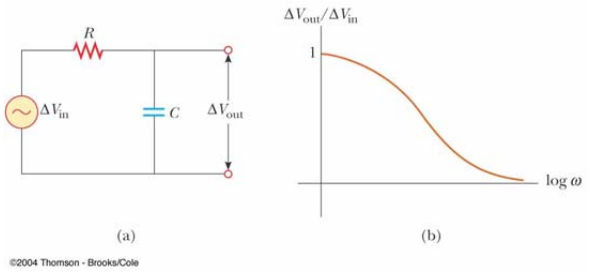
ABSOLUTELY NO CHEATING!

Note: This is a close-book examine. You can use pencil or any pen in answering the problems. Dictionary and Calculators are allowed.

1. **Speed of electric current (20%):** In one of the classes we had calculated the drift velocity of the electrons in copper to be 2.22×10^{-4} m/s (page 27-1 in lecture note), which is not too impressively high. On the other hand, the propagation of electric field, or electrical signaling using electrical signals in a wire is very high (~ close to the speed of light). Current is the moving of the conducting electrons in a conductor, explain why these two numbers don't agree with each other?

2. **Low pass filter:** (20 %) Consider the filter circuit shown in the figure below. (a) Show that the ratio of the output voltage to the input voltage is (5 pts)

$$\frac{\Delta V_{\text{out}}}{\Delta V_{\text{in}}} = \frac{1/\omega C}{\sqrt{R^2 + \left(\frac{1}{\omega C}\right)^2}}$$



(b) What value does this ratio approach as the frequency decreases toward zero? (5 pts) (c) What value does this ratio approach as the frequency increases without limit? (5 pts) (d) At what frequency is the ratio equal to one half? (5 pts)

3. **Motion of electric charge in a uniform electric field:** (20 %) Suppose an electron is flying along the ***x*** direction with a velocity of ***V*** into an area of uniform electric field ***E*** made of a pair of large flat plates (length ***L***, separated by a distance ***D***) of opposite charges. What should be the minimum velocity of the electron, so it can "fly through" the electric field region? Assuming the electron has a mass ***M***, charge ***q***.

4. **L-C circiut:** (20 %)In a L-C circuit, if there is a maximum charge Q_{mas} can be store in the capacitor, what is the charge Q(t), charge as a function of time, in this circuit?

5. **Michelson interferometer (Interference):** (20%) A Michelson is an interferometer made of two mirrors and a beam-splitter. The beam-splitter is place at the same distance to either mirror, splits the beam (light) into two portions that travel perpendicularly to two mirrors respectively. One mirror is fixed, one mirror can move along the beam direction. Suppose you send a laser of wavelength λ into the interferometer, what is the detected light intensity ***I*** as a function of the moving mirror traveling distance ***d***?