Basic Elec. Engr. Lab

ECS 210

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Office Hours:
BKD 3601-7
Tuesday 9:30-10:30
Friday 14:00-16:00

Final Exam

- 2 Parts: A and B.
- Read the instructions and the questions carefully.
- Allocate your time wisely.
- When not explicitly stated/defined, all notations and definitions follow ones given in lecture.

General Rules

- Do not cheat. The use of communication devices including mobile phones is prohibited in the examination room.
- **Closed book. Closed notes**.
- Basic **calculators**, e.g. FX-991MS, are **permitted**, but borrowing is not allowed.
- Write your first name and the last three digits of your ID on each page of your examination paper
- **Units** are important.

Part A

- Feb 21, 2011
- 45 Minutes
  - Check your group assignment.
  - **Group a**: 1:15 – 2:00 PM
    - Do not leave the exam room until the end of the allotted time.
  - **Group b**: 2:15 – 3:00 PM Arrive at least 5 minutes early
- Same rules as midterm….

Instructions for Part A

- 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.
- May use any equipment available on your workbench to solve your questions or verify your answers.
  - May request for new/more resistors/capacitors/inductors/op-amps
- The TAs will not help you debug your circuit.
- Clean your desk/bench before you leave the exam room.

Instructions for Part A (Con't)

- For the problems that ask for **TA's signatures**…
  - Lack of the signature(s) = 0 for the whole part.
  - Having the signatures mean that the values recorded are the same as the values measured.
  - These signatures do not guarantee that you have the correct answers.
- Power Supply:
  The **red light** should be off if you connect the circuit correctly.
  - Turn the power supply off immediately and fix your circuit before you turn the power supply on again.
  - Red light > 10s = 3 pt off your final score (each time)

Part B

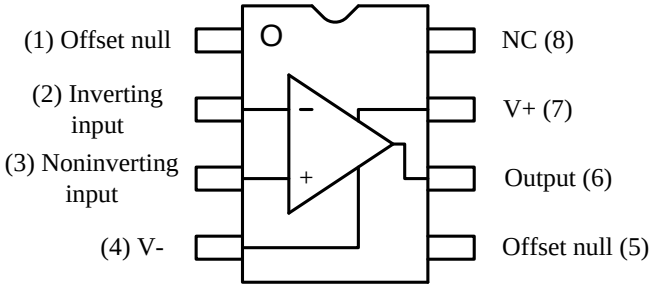
- March 11, 2011
- 09:00 - 11:00 AM
- BKD 3507
- Your scores depend strongly on your explanation. If the explanation is incomplete, zero score may be given even when the answers are correct.

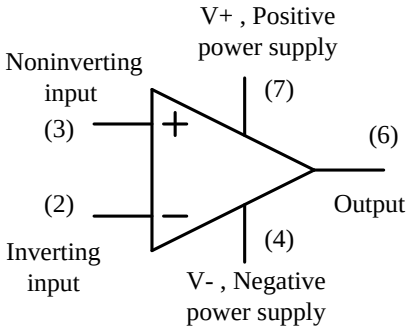
Study

- Lab manuals + slides (posted on the web)
- Make sure that you know how to do all the quiz questions
  - Some of these are included in the practice problems
- Do not forget how to
  - Use the DMM to measure current
    - "break the circuit"
  - Read resistor color codes
    - Green, blue, red = 5.6kΩ
  - Read capacitor values
    - 474 = 0.47 μF

Common mistakes

- How to set up the oscilloscope.
- Know the difference between the DC and AC modes of the **DMM**
  - Know the difference between V_{DC} , V_{AC}, V_{RMS}
- Know the difference between the DC and AC modes of the **oscilloscopes**
- 50Ω inside the **function generator**.
- The op-amp pins info will be provided.



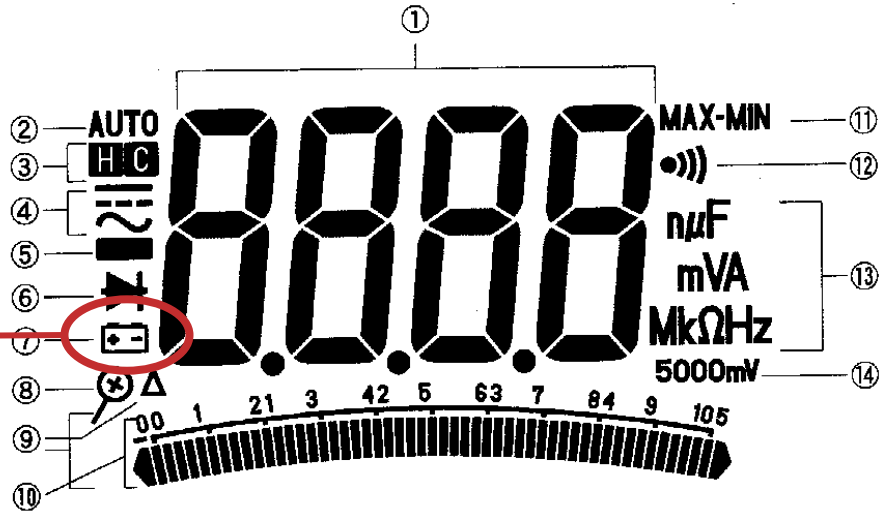


Tips 1

- Try to guess what would be the expected results for each of the problems.
  - This is also why calculator is allowed.
  - Make it easy to know whether something is wrong with your connections/circuit elements

Tips 2

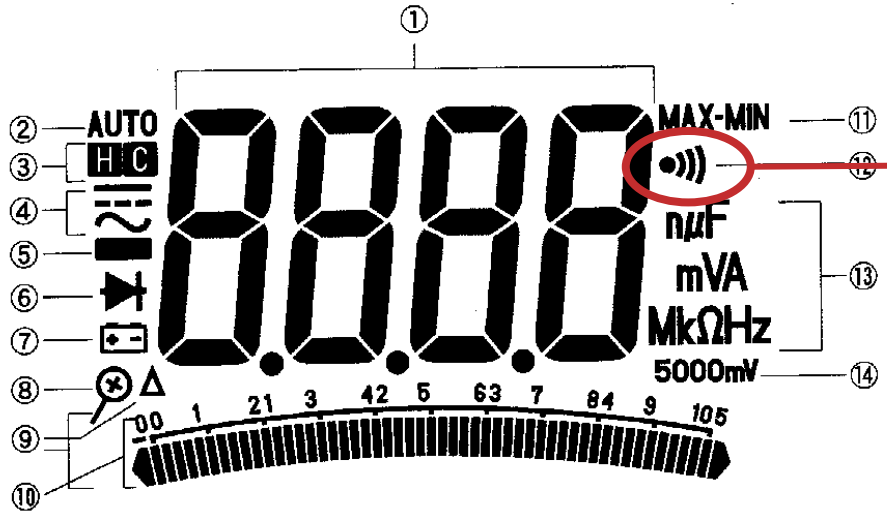
- When the DMM has low battery, it can not make accurate measurement.
- Symptoms
  - Battery discharge warning display
  - Screen starts to fade away.
  - Resistance measurement gives wrong value.



Battery discharge warning display

Tips 3: Continuity Test

- It is very easy to check for broken wire using DMM.
- In the ohmmeter mode, press the select button so that the speaker symbol appear on your screen. Checking continuity display
  - DMM **beeps** = there is good continuity, or a good path that allows current to flow.
  - If there is no continuity, the DMM won't beep.
  - Do not forget to press the select button again (the speaker symbol should disappear) when you want to measure the resistance value.



Checking continuity display

DMM: DC vs. AC

- **Definitions**
  - V_{DC} = Measured value of the voltage using DMM in DC mode
  - V_{AC} = Measured value of the voltage using DMM in AC mode
- Math:
  - V_{DC} = Average value = DC offset voltage = DC component

$$V_{DC} = \overline{v(t)} = \frac{1}{T}\int_{t_0}^{t_0+T} v(t)dt$$

  - V_{RMS} = RMS value

$$V_{RMS} = \sqrt{\overline{v^2(t)}} = \sqrt{\frac{1}{T}\int_{t_0}^{t_0+T} v^2(t)dt}$$

  - V_{AC}

$$V_{AC} = \sqrt{\overline{\left(v(t) - V_{DC}\right)^2}} = \sqrt{V_{RMS}^2 - V_{DC}^2}$$

Tips 4: DMM

- When $V_{DC} = 0$, we have $V_{AC} = V_{RMS}$.
- For square waveform (w/ or w/o DC offset),

$$V_{AC} = \frac{V_{p-p}}{2}$$

- For sinusoidal waveform (w/ or w/o DC offset),

$$v(t) = A\sin(2\pi ft + \phi) + V_{DC}$$

$$V_{AC} = \frac{V_{p-p}}{2\sqrt{2}} = \frac{A}{\sqrt{2}}$$

Today...

- Work on Problem 1-4 (and possibly 5, if time permitted)

Answers

- Problem 1
  - $V_{DC} = 1.000V, V_{AC} = 1.500V$
  - $V_{DC} = 2.000V, V_{AC} = 1.500V$
- Problem 2
  - $V_{1,RMS} = 0.225V$
  - $V_{2,RMS} = 0.451V$
  - $I_{1,RMS} = 0.23\ mA$
- Problem 3
  - $V_{p\text{-}p} = 3V$
  - $V_{RMS} = 0.678V$
  - $V_{RMS} = 0.509V$
  - $V_{RMS} = 1.01V$
  - $V_{RMS} = 0.95V$
- Problem 4

	$V_{p\text{-}p}$	V_{AC}	V_{DC}
V_{in}	2 V	0.675V	0.016V
V_{out}	0.5 V	0.173V	0.116V

- Problem 5
  - $V_{in,RMS} = 1.336V$

f (kHz)	C (μF)	$V_{out,RMS}$
3	0.01	0.535V
3	0.001	5.12V
2	0.01	0.807V
2	0.001	6.68V