Physics 4211, 4112
Laboratory Physics I & II - Spring 2015

Course Information

- **Lecturer:** Professor Randall J. Scalise
- **Lecture meeting time and place:** Tuesday 1:00-1:50pm in room 60 Fondren Science.
- **Laboratory meeting place:** Room 2 Fondren Science Building.
- **Supervised lab times** You MUST show up for one of these:
  - Tuesday 2:00-4:00PM
  - Thursday 2:00-4:00PM
  - Friday 1:00-3:00PM
- **Unsupervised lab times:** any time you wish.
- **Office hours:** in room 107 Fondren Science by appointment.
- **Contact:**
  - Call or leave a message at 768-2504, or
  - Leave a note in the Physics Department Office - 102 Fondren Science, or
  - send me e-mail: <scalise@smu.edu>
- **Texts:**
  - One or more laboratory notebooks of the kind used in PHYS 1105 and 1106.
- **Grading:** 70% Lab reports, 20% Midterm exam, 10% Homework. Late work is given half credit if it is received before the solutions are posted; late work is given no credit if it is received after the solutions are posted.

Lab reports for the modern physics experiments are graded on:

  - physics content including error analysis (50%)
  - grammar, spelling, punctuation, etc. (20%)
  - Quality of reference sources and appropriateness of citations in the report (20%)
  - Format and readability (10%)

- **Syllabus**
- **Homework solutions**
- **Lab rules** from PHYS 1105 and 1106 (some do not apply).
- **Goals/Objectives/Learning Outcomes**
- **Official University Calendar**
- **Students with disabilities, medically excused absences, absences in general**

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Physics 4211/4112
Syllabus - Spring 2015

Week 1
20-24 Jan
Lecture #1: DC circuits, *resistors*, voltage divider, meter errors, Thévenin and Norton equivalents, passive linear devices, *oscilloscope*
Read HH Text:p1-20, Appendix A; HH Manual:p1-31 (skim quickly over Homwork: HH 1.7, 1.8*, 1.9, 1.10, additional 1, 2 (p58); *scalise0* 
* if you miss this one, I know you did not read the assigned pages Lab exercises: 1-1 -- 1-6 (not pages). Due the day before your su

Week 2
27-31 Jan
Lecture #2: AC circuits, capacitors, inductors, impedance, phasors filters, diodes, passive non-linear devices.
Homework: HH 1.13, 1.14, 1.23, 1.24, additional 3, 7; *scalise02*. D 
Lab exercises: 2-1 -- 2-6; 3-2 -- 3-5, 3-7. Due the day before yo

Week 3
3-7 Feb
Lecture #3: Transistors, active devices, switch, emitter follower, common-emitter amplifier, negative feedback. 
Read HH Text:p61-72 (skip 2.06), 76-87; HH Manual:p82-108, 133-119 
Homework: HH 2.2, 2.5; *scalise03*. Due Friday 13 February 2015 at 
Lab exercises: Scalise L1 - Part 2 only, 4-1 -- 4-5, 4-7; 5-2, 5-5. Due the day before your supervised lab meeting.

Week 4
10-14 Feb
Homework: HH 4.1*, 4.2**, 4.3, derive $V_{out}$ in figure 4.18 page 185. * for a pnp transistor, $V_{E} - V_{B} = 0.6V$, the opposite for the nnp trar ** Howland Current Source animation. 
Lab exercises: 8-1 -- 8-4, 8-6. Use the photodiode or the phototr a compact fluorescent lamp (CFL), and an incandescent lamp; find t Due the day before your supervised lab meeting.

Week 5
17-21 Feb
Lecture #5: Operational amplifiers (op-amps) II, nightlight feedba ring oscillator; Chua's circuit and chaos. 
Homework: HH 4.6, Explain in crisp, specific language why the circ acts as an active clamp. Suppose you wanted the clamp voltage to b (or so) and not 10 V. What would you change? Due Friday 27 Febru Lab exercises: All except 9.4. Due the day before your supervised
Week 6  Lab: start **Franck-Hertz** (2 weeks)

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Spring Break

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Week 7  Midterm examination Tuesday 17 March. There will be both written
17-21 Mar  You may use your notebook and homework, but neither the text nor t

Week 8  Lecture #7:
Homework: Taylor 4.6, 4.7, tec0, tec1. Due Friday 27 March 2015 a
Lab: **Franck-Hertz**

Week 9  Lecture #8:
31 Mar - 4 Apr  Read Taylor chapter 5.  
Homework: Taylor 5.6 (be sure to draw it), tec2, tec3. Due Monday
Lab: **Nuclear Magnetic Resonance** (3 weeks)

Week 10  Lecture #9:
Read Taylor chapters 6 and 7.  
Homework: Taylor 7.4, tec4, tec5. Due Friday 10 April 2015 at 5:0
Lab: **Nuclear Magnetic Resonance** (continued)

Week 11  Lecture #10:
Read Taylor chapter 8. **Least Squares fitting**, **Vertical vs. perpen**
Homework: Taylor 8.22, 8.24, tec6. Due Friday 17 April 2015 at 5:
Lab: **Nuclear Magnetic Resonance** (continued)

Week 12  Lecture #11:
Read Taylor chapter 9.  
Homework: Taylor 9.16. Due Friday 24 April 2015 at 5:00pm.
Lab: **Muon counter** (3 weeks)
**Large muon data set**

Week 13  Lecture #12:
Read Taylor chapter 10.  
Homework: Taylor 10.20, 10.21. Due Friday 1 May 2015 at 5:00pm.
Lab: **Muon counter** (3 weeks)
Week 14  Lecture #13:
Read Taylor chapter 11.
Homework: Taylor 11.3, 11.4, 11.19. Due before the Sun becomes a red giant star.
Lab: Muon counter (continued)

Week 15  Lecture #14:
Read Taylor chapter 12.
Homework: Taylor 12.3. Due before the heat death of the Universe.
Lab: Muon counter (continued).
• R1 = 1000 ohm (between A and C)
• R2 = 2200 ohm (between C and B)
• R3 = 560 ohm (between A and D)
• R4 = 330 ohm (between D and B)
• R5 = 1000 ohm (between C and D)

1. Are any resistors in series? Are any resistors in parallel?

2. Imagine removing the battery creating an open circuit. Find the resistance between A and B in the circuit.
What are the four currents an instant after the switch is closed? (Positive values if the currents are flowing in the directions indicated; negative if flowing the opposite direction.)

What are the four currents a long time after the switch has been closed?

What are the four currents an instant after the switch is opened again, after having been closed for a long time?
Design a common emitter amplifier of nominal gain $g = -10$ to work at $f = 100$ kHz. Let the supply voltages $V_{CC} = +12$ V, $V_{EE} = -12$ V. Center the output voltage as best you can. Use capacitive coupling and set the quiescent current at 1.0 mA.
1. What is the resistor color code for a 5.1 MΩ resistor with 10% tolerance?

2. What is the capacitance of a cap marked “335J”? 

3. What is a voltage gain of +4 in dB?

4. What is $\frac{V_{out}}{V_{in}}$ as a percentage if the attenuation is -20 dB?

5. Draw a full-wave rectifier labeling Vin and Vout.

6. Draw a common emitter amp labeling all parts. What is the output impedance?

7. Design using only transistors an audio amp with gain = +6 to drive a 100 kΩ load.

8. The Bode plot for a low-pass filter has a straight line after rolloff with slope -6bD per octave. Explain the preceding statement in detail. Include something like: if the frequency changes by __________ then the output voltage changes by __________.

9. What is the output of this circuit if the input is 10mV sin(100 t)? Draw the input and output vertically displaced on the same horizontal time axis (like scope traces). Explain in detail how the circuit works.