# EE230 Course outline

January 2019

**Analog Circuits Lab – EE 230**

**Course Instructor:**

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# LEARNING OBJECTIVES

**Basic:**
- Learn how to use basic electrical characterization equipment
- Learn how to analyze basic op-amp circuits

**Intermediate:**
- Predict and interpret circuit performance
- Design test setups and circuits to perform task at hand

**Advanced:**
- Apply concepts from other courses to the lab, and vice versa
- Absorb the underlying techniques and apply them to other circuit applications

# LIST OF TOPICS TO BE COVERED

1. AFG and DSO familiarization (not graded)

**\*Op-amp related labs:**

2. Differential amplifiers and current mirrors

3. Non-idealities of op-amps

**\* Instrumentation amplifier related labs:**

4. Instrumentation amplifier design and sensor (load cell) interfacing

5. Nonlinear circuits

**\* Applications – I: Filters and Oscillators:**

6. Voltage controlled oscillator

7. Active filter circuits

8. Narrow band filters and frequency synthesis (Fourier series)

**\* Applications – II: Phase sensitive detection (PSD):**

9. Phase sensitive detection circuits, extraction of signal buried in noise

10. Application of PSD: gray scale detection (how dark is dark)

# WHAT WILL BE DONE DIFFERENTLY FROM EE236?

- Pre-midsem: *Instructional* labs, Post-midsem: *Project-style (application)* labs

- More emphasis on design oriented learning than mere execution of experiments

- Simulation (ngspice) exercises included in few labs; additional exercises to be included in EE204

- Surprise quizzes in beginning of <u>some</u> labs (to test pre-lab reading)

- Course project

# GROUND RULES – I

- Every student must have their own lab notebook, that is used solely for this course. It must be signed by your TA after every lab. Every lab notebook must contain:
  - Hand drawn circuit diagrams with pin numbers clearly written for every lab
  - Readings to be manually recorded in lab notebook. If you prefer recording in excel, you are welcome to do so, provided you also record in notebook.
  - Experimental conditions (applied voltages, signals etc.), observations, conclusions neatly documented
  - The instructor reserves the right to **withhold all credit** for in-lab component of grade if these instructions are not followed

- Lab report must be written in template provided on website for each lab. Reports must be written in LaTEX. Circuit diagrams in report must be made with Xcircuit and plots must be made with GNUplot, Origin, Python/MATLAB, or any professional plotting software (except MS Word/Excel). No late submissions!

- You must bring your lab kit to every lab. Attendance and punctuality is compulsory.

# GROUND RULES – II

- No deadline extensions henceforth for report submissions

- If you are late for submission on moodle, you lose all credit for the corresponding report

- If you fail to upload the report on moodle, you **must not** email it to your TA and/or the instructor and/or the lab staff. Any such emails will result in 5 marks being deducted (per email) from the overall course total.

- **Instructor will conduct surprise notebook inspection. Any single violation of notebook entry rules (see previous slide) will result in you losing all credit for in-session component of the grade (20%).**

# HELPFUL TIPS

- Please devote as much time as you deem reasonable towards writing reports. We expect approximately 4 hours of effort outside lab hours every week for this course (more effort for project track, in subsequent labs)

- If you are unable to meet deadlines, ask yourself how you can improve your efficiency, instead of asking for deadline extension/work reduction

- Before coming to lab: read all handouts, and perform a mental calculation for how long you think each of the steps in the experiment may take. If some preparation at home will help you utilize lab time better (e.g. drawing circuit diagram with IC pin numbers marked clearly), include this in your routine

- Identify appropriate time management schemes to address all your tasks by splitting them into sub-tasks and interleaving

# LOGISTICS

- The class is divided in two batches:

    Batch A (Dual Deg.) on Mondays 2 pm to 5 pm

    Batch B (B. Tech.) on Tuesdays 2 pm to 5 pm

- You will be working in pairs. Pairs, seating arrangement and TA allotment will be posted on moodle and course webpage.

- Venue: Wadhwani Electronics Lab-4 (WEL-4)

- Slots for Machines lab and Digital lab will be coordinated to ensure no conflict with this course

# GRADING POLICY (TENTATIVE)

**In session marks**                    20%

**Each experiment carries weightage for pre-lab (ngspice simulations) wherever applicable, <u>notebook entry</u> and post-lab (report)**

**Project**                    30%

**Mid semester exam**          20%

**End semester exam**          30%

# PROJECT

- You may form project team (pairs) of your choice i.e. need not be the same as regular lab group

- We will share seed ideas and guidelines for projects in few weeks. Project topics and teams must be proposed by Jan 31$^{st}$ (tentative)

- Project carries 30% weightage, and is not compulsory. If you choose to not do a project, you may do two additional labs (audio amplifier design, and analog multiplier circuits) for a maximum of 20% weightage in lieu of project

- If your project proposal is not up to the mark, we will reject it, and instead you must perform the two additional experiments for maximum 20% weightage