1. Course number and name
   ENGR 445: Analog Integrated Circuit Design

2. Credits and contact hours
   4 credit hours

3. Instructor's or course coordinator's name
   Instructor: Hao Jiang, Assistant Professor
   Course coordinator: Hao Jiang, Assistant Professor

4. Text book, title, author, and year
   Sergio Franco, Engr 445 Notes: An Introduction to Analog Integrated Circuits Design,
   distributed the SFSU Student Chapter of the IEEE Society.

   a. other supplemental materials
      • P. R. Gray, P. J. Hurst, S. H. Lewis, and R. G. Meyer, Analysis and Design of Analog
      • Sergio Franco, An Introduction to Microelectronics, University Readers, 2009

5. Specific course information
   a. brief description of the content of the course (catalog description)
      Integrated circuit technology, transistor characteristics and models. Analysis and design
      of monolithic op amps. Frequency response, negative feedback, stability, PSpice
      simulation.

   b. prerequisites or co-requisites
      Grades of C or better in Engr 353 and ENGR 301

   c. indicate whether a required, elective, or selected elective course in the program
      Elective for Electrical Engineering.

6. Specific goals for the course
   a. Specific outcomes of instruction, ex. The student will be able to explain the significance
      of current research about a particular topic.
      • To study basic semiconductor principles and analog IC technolog.
      • To study analog IC building blocks up to the complete 741 op amp.
      • To investigate the frequency response of analog ICs.
      • To study negative feedback, stability, and frequency compensation.
      • To observe and measure the performance of analog ICs in the laboratory.
      • To perform the SPICE simulation of simple digital circuits.

   b. Explicitly indicate which of the student outcomes listed in Criterion 3 or any other
      outcomes are addressed by the course.
      • Students will demonstrate an understanding of pn junction properties and i-v
        characteristics.
Course Online

- Students will demonstrate an understanding of BJT properties, characteristics, and models.
- Students will become conversant with analog IC technology and fabrication techniques.
- Students will demonstrate an understanding of classical single-transistor and two-transistor configurations.
- Students will demonstrate an understanding of basic analog IC building blocks (current sources, active loads, and output stages).
- Students will demonstrate an ability to perform the DC and small-signal analysis of a complete IC op amp (741).
- Students will demonstrate an ability to investigate the frequency response of basic analog IC building blocks.
- Students will demonstrate an ability to investigate the small- and large-signal transient response of an IC op amp.
- Students will demonstrate an ability to identify and analyze classic negative-feedback topologies.
- Students will demonstrate an ability to assess the stability of a negative-feedback circuit.
- Students will become conversant with the most common frequency-compensation techniques.
- Students will demonstrate an ability to characterize electronic devices experimentally.
- Students will demonstrate an ability to characterize analog building blocks experimentally.
- Students will demonstrate an ability to design and characterize a breadboard version of an IC op amp.
- Students will demonstrate a skill in the SPICE simulation simple analog circuits.
- Students will demonstrate a skill in the SPICE simulation of basic analog building blocks using measured parameters.

7. Brief list of topics to be covered
   - Models for integrated-circuit active devices
   - Bipolar and MOS integrated-circuit technology
   - Single-transistor and two-transistor amplifiers
   - Current sources, active loads, and output stages
   - Large-signal and small-signal analysis of the 741 op amp
   - Frequency and time responses of integrated circuits
   - Negative feedback
   - Frequency response, stability, and frequency compensation of negative-feedback amplifiers