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,
   Course coordinator: Hao Jiang, Associate Prof. in EE

4. *Text book, title, author, and year*
   Tony Chan Carusone, David A. Johns, and Kenneth W. Martin, "Analog Integrated Circuit Design" 2nd Edition.Wiley, 2011 (ISBN: 0470-77010-4)

   a. other supplemental materials
   1. Philip Allen and Douglas Holberg, "CMOS Analog Circuit Design"3rd, Oxford Press, 2011
   2. Behzad Razavi"Design of Analog CMOS Integrated Circuits**"**McGraw-Hill, 2000

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, circuit simulation.

   b. *prerequisites or co-requisites*
      Grades of C- or better in Engr 353 and Engr301

   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 technology.
      - To study analog IC building blocks up to the complete op amp.
      - To investigate the frequency response of analog ICs.
      - To study negative feedback, stability, and frequency compensation.

- To design and simulate the performance of analog ICs in the laboratory.

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.
- Students will demonstrate an understanding of CMOS transistor 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 op amp.
- Students will demonstrate an ability investigate the frequency response of basic analog IC building blocks.
- Students will demonstrate an ability to investigate the small- and large-signaltransient 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-compensationtechniques.
- Students will demonstrate an ability to characterize electronic devices using circuit simulation tools.
- Students will demonstrate an ability to characterize analog building blocks using circuit simulation tools.

7. Brief list of topics to be covered

- Models for integrated-circuit active devices
- CMOS integrated-circuit technology
- Single-transistor and two-transistor amplifiers
- Current sources, active loads, and output stages
- Large-signal and small-signal analysis of an op amp
- Frequency and time responses of integrated circuits
- Negative feedback

- Frequency response, stability, and frequency compensation of negative-feedback amplifiers