1. **Course number and name**  
**ENGR 442: Operational Amplifier Network Design**

2. **Credits and contact hours**  
3 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**  

5. **Specific course information**  
a. **brief description of the content of the course (catalog description)**  
Design of op-amp based amplifiers, signal converters, conditioners, filters. Negative feedback, practical op-amp limitations. Voltage comparators; Schmitt triggers; nonlinear signal processing. Sinewave oscillators; multivibrators; timers.

b. **prerequisites or co-requisites**  
Grades of C- or better ENGR 305

c. **indicate whether a required, elective, or selected elective course in the program**  
Required for Electrical Engineering and Elective for Computer 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 investigate a variety of resistive op–amp circuits with emphasis on feedback principles.  
- To analyze and design active filters  
- To investigate the effect of op–amp non-idealities upon the DC as well as the AC and transient responses of popular op–amp circuits  
- To study the design of popular op–amp and comparator applications in test, control, and instrumentation  
- To perform SPICE simulation of common analog circuits.

b. **Explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course**  
Course addresses ABET Student Outcome(s): a, c, k.
• Students will demonstrate the ability to analyze and design a variety of popular op-amp circuits, including signal converters and instrumentation blocks.
• Students will demonstrate an understanding of the curative properties of negative feedback.
• Students will demonstrate an ability to identify negative-feedback topologies and estimate the loop gain of a circuit.
• Students will become conversant with systems poles, zeros, and Bode Plots as applied to op–amp circuits.
• Students will demonstrate an ability to analyze and design first-order op–amp filters.
• Students will demonstrate an ability to analyze and design second-order active filters and compare different topologies.
• Students will become conversant with the internal structure of a practical op–amp and the origins of its nonidealities.
• Students will demonstrate a skill in using data sheets to assess the limitations of practical analog ICs.
• Students will demonstrate an ability to predict the effect of static op–amp limitations upon DC circuit performance.
• Students will demonstrate an ability to predict the effect of dynamic op–amp limitations upon circuit performance in both the frequency and time domains.
• Students will become conversant with a variety of popular test, control, and instrumentation blocks (comparators, Schmitt triggers, precision rectifiers, SHAs, timers, function generators, VCOs, and $V-F$ and $F-V$ converters).
• Students will be capable to assess the impact of component nonidealities upon circuit performance.
• Students will demonstrate a skill in the PSpice simulation of the circuits investigated in the course.

7. Brief list of topics to be covered

• Review; basic closed-loop configurations; negative feedback; op–amp powering and saturation.
• $I-V$, $V-I$, and $I-I$ converters; difference and instrumentation amplifiers.
• 1st-order filters. 2nd-order active filters: $KRC$, multiple feedback, state-variable and biquads.
• Input-referred DC errors; drift; CMRR and PSRR; operating limits.
• Frequency response; input and output impedances; small-signal and large-signal transient response.
• Voltage comparators and Schmitt triggers; precision rectifiers; peak detectors and sample-and-hold amplifiers.
• Sinusoidal oscillators; multivibrators; IC timers; waveform generators; VCOs.