

<b>Course name</b>	<b>ECE45500: Integrated Circuit Engineering</b>
<b>Credit and contact hours</b>	(3 cr.) Class 3
<b>Course coordinator's name</b>	Maher Rizkalla
<b>Textbook</b>	Analysis and design of Analog Integrated Circuits, by Gray, Hurst, Lewis, and Meyer, Fifth Edition, Wiley: ISBN 978-0-470-24599-6
<b>Course information</b>	<p>Analysis, design and fabrication of silicon bipolar and MOSFET monolithic integrated circuits. Consideration of amplifier circuit design, and fabrication techniques with circuit simulation. Integrated operational amplifiers with difference amplifiers, current sources, active loads, and voltage references. Design of IC analog circuit building blocks.</p> <p><b>Prerequisites/ Co-Requisite</b>  P: ECE 25500</p> <p><b>Required, Elective, or Selected Elective:</b>  EE Elective</p>
<b>Goals for the course</b>	<p>Upon successful completion of the course, students should be able to</p> <ol style="list-style-type: none"> <li>1. an ability to sketch the basic cross-sections of an integrated circuit transistor. [1,4]</li> <li>2. an ability to layout a simple transistor circuit. [2]</li> <li>3. an ability to, given a layout and silicon parameters, calculate parasitic resistance and capacitance for transistors. [1]</li> <li>4. an ability to, given transistor characteristics and operating point, determine the numerical values of the elements in the small signal equivalent circuit. [1]</li> <li>5. an ability to design a suitable integrated circuit current source. [1,2]</li> <li>6. an ability to, given the parameters of gain, input impedance and output impedance, design a suitable amplifier using either MOS or bipolar transistors and verify with SPICE. [1,2,5,6]</li> <li>7. an ability to design a simple operational amplifier, numerically estimate large signal and small signal characteristics, and verify the calculations with a SPICE simulation. [1,2,3,4,5]</li> </ol>
<b>List of topics to be covered</b>	<ul style="list-style-type: none"> <li>• Introduction to IC processing for bipolar and MOS circuit fabrication</li> <li>• Models for IC BJT and MOSFET devices: Operating point (DC non-linear) and linear high frequency small signal</li> <li>• Multiple FET and BJT composite amplifiers</li> </ul>

	<ul style="list-style-type: none"> <li>• Differential Amplifier; common mode and differential mode gain, <math>R_{in}</math> and <math>R_{out}</math>, design to meet specifications</li> <li>• NPN and PNP current sources in Difference Amplifiers; output resistance of I-sources, MOSFET and BJT self-biased current sources and voltage references</li> <li>• Output Stages</li> <li>• The Operational Amplifier</li> <li>• Special Topics</li> </ul>
<b>Syllabi approved by</b>	Maher Rizkalla
<b>Date of approval</b>	04/10/2021