

**University of Waterloo**  
**Department of Electrical and Computer Engineering**  
**E&CE 444 Integrated Analog Electronics**  
**Winter 2014**  
**Tentative Course Outline**  
**Instructor: Professor Bosco Leung**

Topic	Tentative number of Lectures
Differential gain stages/ Advanced current sources and active loads	8
MOS opamps	6
Bipolar Opamps	4
Midterm	
Frequency response using zero value time constant method	6
Feedback amplifiers and loading	5
Stability and Compensation	3
Output stages	1
Selected topics of current interest e.g. A/D, D/A converters, phase locked loop, oscillators	4

The course focus on practical design techniques for analog and mixed analog/digital integrated circuits. The goal is to develop the necessary circuit design techniques which enable students to design practical mixed analog/digital circuits such as amplifiers, A/D converters, phase locked loops for applications ranging from wireless communication, video imaging to biomedical-instrumentation etc. The course is built on ECE 241/240 and ECE 332/242 and the emphasis is on design so that relevant design issues will be highlighted. Along with derivation of formulae for the circuits, important design intuition is introduced. We will cover advanced current sources such as Widlar/Wilson current sources, advanced active loads for doing differential to single-ended conversion. Multi-stage bipolar opamp, CMOS opamps will be covered.

## Project

There is a CMOS design project (typically team project) for the course using Cadence as the simulator. The performance objectives (such as frequency of operation/power/etc) will be given and the goal is to come up with a circuit topology to meet those objectives, under realistic constraints. In the past, from the list of circuits such as operational amplifiers, A/D converters, low noise amplifiers, mixers, voltage control oscillators etc., a specific circuit has been selected to be used in design projects.

Tentative Marking Scheme      Mid-term: 20%, Project: 30%, Final: 50%

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ECE 444