Analog IC Design - Video course

COURSE OUTLINE

This course deals with design of analog integrated circuits with emphasis on the design of feedback circuits at the transistor level.

This course is for first year postgraduate students and final year undergraduate students who have already taken a course on analog circuit design.

COURSE DETAIL

Sl.No	Topics	No. of Classes
1	**Course introduction**	**1**
2	**Negative feedback systems and stability**	**10**
	Negative feedback amplifier using an integrator; Frequency and time domain behavior; Loop gain and its implications; Negative feedback amplifier realization; Finite DC gain; Increasing DC gain; Effect of multiple poles; Negative feedback systems with multiple poles and zeros in the forward path; Stability analysis using Nyquist criterion; Nyquist criterion; Loop gain-Bode plot and time domain interpretation; Significance of 60 degree phase margin	
3	**Opamp at the block level; Frequency compensation**	**7**
	Concept of the opamp for realizing negative feedback circuits; Realizing a multi stage opamp-frequency compensation-miller opamp; Realizing a multi stage opamp; feedforward compensated opamp; Opamp as a general block; unity gain compensation; nonidealities-swing limits, slew rate, offset; dc negative feedback around opamps	
4	**Opamp amplifiers**	**1**
	Amplifiers using Miller compensated opamp; Effect of input capacitance; gain bandwidth product; Transimpedance amplifier; lead-lag compensation; Inverting and noninverting amplifiers-CMRR and its importance	
5	**Components available on an IC**	**4**
	IC components and their models; Mismatch; Layout considerations	
6	**Noise in resistors and MOS transistors**	**3**

NPTEL

http://nptel.iitm.ac.in

Electronics & Communication Engineering

Pre-requisites:

1. An undergraduate course in analog circuits.
2. An undergraduate course in networks and systems.

Additional Reading:

1. *Analog Circuit Design: Art, Science and Personalities (EDN Series for Design Engineers) (Paperback), Jim Williams, Newnes; Reprint edition, 1991.*
2. *Analog Integrated Circuit Design*, David Johns and Ken Martin, John Wiley & Sons, 1997.
3. *Mixed Analog Digital VLSI Devices and Technology (An introduction)*, Y. Tsividis, World Scientific, New Jersey, 2002.
4. *Analysis and design of Analog Integrated Circuits*, Gray, Hurst, Lewis, and Meyer, 4th Edition, John Wiley and Sons.
5. *Design of Analog Integrated Circuits and Systems*, K. R. Laker and W.M.C. Sansen, McGraw-Hill, January 1994.

Hyperlinks:

1. http://www.ee.iitm.ac.in/~nagendra/teaching.html

Coordinators:

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	Noise models; Noise calculations; Noise scaling	
7	**Review of basic amplifier stages**	**1.5**
	Body effect in basic amplifier stages; Frequency response of a common source amplifier	
8	**Single ended opamp design**	**10.5**
	Realizing a single stage opamp-diff pair; small signal ac analysis; Single stage opamp-mismatch and noise; Single stage opamp-telescopic cascode; Replica biasing a cascode; Single stage opamp-folded cascode; Two stage miller compensated opamp; Three stage opamp; CMRR of an opamp and opamp circuits	
9	**Fully differential opamp design**	**5**
	Fully differential opamps; Differential and common mode half circuits; common mode feedback; Fully differential miller compensated opamp-common mode feedback loop and its stability; Fully differential single stage opamp; Fully differential telescopic cascode opamp; Fully differential feedforward compensated opamp	
10	**Phase locked loop**	**8**
	Frequency multiplier-Phase locked loop; Lock range limitations; type II loop; Jitter & Phase noise; Continuous time approximation; PLL transfer functions; Reference feedthrough spurs; LC oscillators	
11	**Reference voltage and current generators**	**2.5**
	Bandgap reference; Bandgap reference; Constant current and constant gm bias generators	
12	**Low dropout regulators**	**1.5**
	Low dropout regulators; Basic requirements and constraints	
13	**Continuous time filters**	**2**
	Active RC filters using integrators	
14	**Switched capacitor filters**	**1**
	Switched capacitor filters using the bilinear transformation	
15	**Circuit simulators**	**2**

	Basic analyses; Simulating loop gain	
	Total No. of Classes	**60**

References:

1. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, McGraw-Hill, August 2000.