17VL001 ANALOG IC DESIGN

Hours Per Week :

L	T	P	C
3	-	3	5

Total Hours :

L	T	P	WA/RA	SSH/HSH	CS	SA	S	BS
45	-	45	15	30	-	5	5	-

Course Objectives:

With an emphasis on CMOS technology, device models are briefly reviewed and developed further to cover channel-length modulation, sub threshold and short channel effects, as well as device parasitic capacitances. Integrated-circuit DC biasing techniques are presented starting from simple to more complex current mirrors, leading to analysis and design of current and voltage references. Temperature and power supply sensitivity, as well as absolute and mismatch parameter variations are introduced.

Course Outcomes:

- Develop an understanding of device and circuit theory sufficient to estimate the low and high frequency behavior of linear circuits, including noise.
- Develop an intuition for analog circuit behavior in both linear and nonlinear operation.
- Develop an ability to parse large circuits and systems into smaller, analyzable subunits, analyze them, and then apply the understanding gained from that process to analyze the system as a whole, including for noise and variation.
- Implement a circuit or subsystem at the transistor level to solve an open-ended problem and effectively communicate the constraints and critical aspects of that system.

SKILLS:

- Analog circuits design and verification techniques
- Detailed knowledge of the complete analog circuits design and analysis flow.

ACTIVITIES:

- *Current mirrors and Amplifiers.*
- *Frequency response analysis of Op-Amps.*
- *Able to do noise analysis.*

UNIT –I

CMOS device fundamentals: Basic MOS models, device capacitances, parasitic resistances, substrate models, transconductance, output resistance, frequency dependence of device parameters.

UNIT –II

Current Mirrors and Single stage amplifiers: CMOS current mirror, Common source amplifier, common drain amplifier or source follower, Common gate amplifier, Source degenerated current mirror, High output impedance current mirrors; Casode current mirror, Wilson current mirror, Cascode gain stage , MOS differential pair

UNIT –III

Frequency Response of Amplifiers: Miller effect, Common Source amplifier, Source follower amplifier, Common gate amplifier, Cascode gain stage.

UNIT –IV

Feedback topologies and Noise: Input mixing, Output sampling, Noise: Statistical characteristics, types of noise, Noise summation, Noise spectral density, White noise, 1/f or flicker noise, Noise bandwidth.

UNIT – V

CMOS Operational Amplifiers: Classification of Op Amps, Design of Op Amps, Compensation of Op Amps, Performance parameters, Design of two-stage Op Amps, Gain boosting, common mode feedback, Input range, slew rate, Power supply rejection, Noise in Op Amps. Stability and frequency Compensation, Buffered Op-amps, High speed / Frequency Op-amps, Differential output op-amps, low noise and low voltage op-amps.

LABORATORY EXPERIMENTS

LIST OF EXPERIMENTS

I) Design and simulate the following analog circuits.

1. Verify the characteristics of nMOS and pMOS Transistor
2. Common Source Amplifier
3. Common Drain Amplifier
4. Common Gate Amplifier
5. Current Mirror
6. Cascaded Current Mirror
7. Differential Amplifier
8. CMOS Op-amp single Stage
9. Two stage operational amplifier
10. Cascade Amplifier
11. Folded Cascode amplifier
12. Push Pull Amplifier
13. Current Controlled Voltage source

II) Layouts

TEXT BOOKS:

1. Behzad Razavi, Design of Analog CMOS integrated circuits, McGraw-Hill International edition, 2002.
2. D. A. Johns and Martin, Analog Integrated Circuit Design, John Wiley, 1st edition 1997.
3. Paul B Gray and Robert G Meyer, Analysis and Design of Analog Integrated Circuits, 5th edition, Wiley, 2009.
4. Phillip E.Allen and Douglas R.Holberg, CMOS Analog Circuit Design, Oxford University Press, 1st edition, 2007.

REFERENCE BOOKS:

1. R Gregorian and G C Temes, Analog MOS Integrated Circuits for Signal Processing, John Wiley,1st edition, 1986.
2. R L Geiger, P E Allen and N R Strader, VLSI Design Techniques for Analog & Digital Circuits, McGraw Hill, 3 rd edition, 1990.
3. Gray, Wooley, Brodersen, "Analog MOS Integrated circuits", IEEE press, 1st edition, 1989.