DISCIPLINE SPECIFIC ELECTIVES (DSE-3)

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
CMOS Analog VLSI Design ELDSE8C	4	3	-	1	Class XII passed with Physics + Mathematics/Applied Mathematics + Chemistry OR Physics + Mathematics/Applied Mathematics + Computer Science/Informatics Practices	Digital Electronics, Analog Electronics-I & II, Basic VLSI Design

Learning Objectives

This course introduces the student to the fundamental understanding of Analog Circuits, Switched Capacitor Circuits, Phase locked loops, Converters and Filters.

Learning outcomes

On successful completion of this course, student will be able to:

- Extend the mixed signal design to different applications
- Comprehend the concept of Switched Capacitor Circuits
- Understand different types of Phase Locked Loops
- Build Mixed Signal Circuits and understand different Continuous Time Filters
- Analyze the Data Converter architecture and choose the most appropriate Data Converter for the specified applications

SYLLABUS OF ELDSE-8C **Total Hours- Theory: 45 Hours, Practicals: 30 Hours**

UNIT – I (09 Hours)

CMOS Analog Circuits: Current Sources and Sinks, Current Mirror, Differential Amplifiers, Operational Amplifiers-Basic CMOS Op-Amp design, Operational Transconductance Amplifiers, CMOS Instrumentation Amplifier.

UNIT – II (12 Hours)

Switched Capacitor Circuits: Overview of Switched Capacitor circuits, Basic building blocks, Operation and Analysis, Non-ideal effects in Switched Capacitor Circuits, Switched Capacitor Integrators, First Order Filters

UNIT – III (09 Hours)

Continuous Time Filters: Overview of gm-C (Transconductor-C) filter, CMOS Transconductance Amplifier using Triode and active transistors, MOSFET-C filters

UNIT – IV (15 Hours)

Phased Locked Loop (PLL): Simple PLL, Basic PLL topology, Dynamics of Simple PLL, Overview of Charge Pump PLLs, Applications: Frequency Multiplication and Synthesis and Skew reduction.

Data Converter Fundamentals: Sample and Hold Circuit, Ideal D/A and A/D converter, Quantization Noise, Performance limitations. Types of A/D and D/A converters (overview of any one or two)

Practical component (if any) – CMOS Analog VLSI Design Lab

(Practicals to be performed using Ngspcie/LTspice/QUCS, CADENCE/MENTOR GRAPHICS)

Learning outcomes

The Learning Outcomes of this course are as follows:

- Apply VLSI design methodologies to analyze and design the Analog Circuits
- Comprehend the design and working of Mixed Signal Circuits
- Get familiarized with the VLSI design Simulation Tools

LIST OF PRACTICALS (Total Practical Hours- 30 Hours)

1. Implement a Current Mirror Circuit
2. Implement an Operational-Transconductor Amplifier
3. Implement a Sample and Hold Circuit for a given sampling rate.
4. Implement a First order Switch Capacitor Filter
5. Implement a Simple Phase Locked Loop Circuit
6. Implement a Single-ended First Order Gm-C Filter
7. Implement an A/D converter or D/A converter

Note: Students shall sincerely work towards completing all the above listed practicals for this course. In any circumstance, the completed number of practicals shall not be less than six.

Essential/recommended readings

1. R. Jacob Baker, CMOS Mixed-Signal Circuit Design, Wiley Interscience, 2nd Edition, 2008, ISBN-10 0470290269, ISBN-13 9780470290262
2. Tony Chan Carusone, David Johns, Kenneth Martin, Analog Integrated Circuit Design, Wiley Student Edition, 2013, ISBN-10 9788126543939, ISBN-13 978-8126543939
3. Behzad Razavi, Design of Analog CMOS Integrated Circuits, TMH Edition, 2nd Edition, 2017, ISBN-10 938706784X, ISBN-13 978-9325983274

Suggestive readings

1. Philip E. Allen and Douglas R. Holberg, CMOS Analog Circuit Design, Oxford University Press, International Second Edition/Indian Edition, 2016, ISBN-10 0199765073, ISBN-13 978-0199765072

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.