Syllabus and Lecture Break-up for New Course Titled "VLSI Data Converter Design"

- **Syllabus:** Ideal Sampling, Reconstruction, Quantization, FFT, Windowing, Switched Capacitor Circuits, Noise in MOSFET and BJT, Noise in Switched Capacitor Circuits, System level introduction to Digital-to-Analog Converter (DAC) and Analog-to-Digital Converter (ADC), Performance metrics of DACs and ADCs, Nyquist-Rate DACs (resistor-string (R2R), current-steering, and capacitive), Nyquist-Rate ADCs (Flash, 2-Step, Folding, Folding-Interpolating, Pipelined, and SAR), Quantization Noise Shaping, Oversampled Converter Basics, Case Study: ADC requirements, topology, and design for RF Receivers and Sensor Interface Systems.
- **Lecture Breakup (Based on 14 weeks of lecture per semester ≈ 40 lecture hours/semester)**

Sl. No.	Modules and Tentative Topics in a Module	Approx. Hours
1.	Ideal Sampling, Reconstruction	1
2.	Quantization, Quantization noise Probability Distribution Function (pdf) and Cumulative Distribution Function (cdf), Spectrum of Quantization Noise, Derivation of signal-to-noise ratio (SNR) for signals having different pdf.	1
3.	Concept of Windowing, Different Types of Windows, Fast Fourier Transform (FFT)	1
4.	Introduction to Switched Capacitor (SC) Circuits, Sample-and-Hold topologies using SC circuits, SC Circuit based comparators, SC Common-Mode Feedback Circuits	5
5.	Performance Metrics of ADCs and DACs.	2
6.	Nyquist Rate DACs, R2R DAC, Capacitive DAC, Current Steering DAC,	5
7.	Comparators, regenerative time-constant. Revisit SC-based comparators, Comparator non-idealities, Mitigating comparator non-idealitites	1
8.	Flash ADC Hands-on design of Flash ADC	3
9.	2-step ADC	2
10.	Folding and Interpolating ADC	3
11.	Pipelined ADC Hands-on Design of Pipelined ADC	4
12.	Successive Approximation Register (SAR) ADC Hands-on Design of SAR ADC	3
13.	Quantization Noise Shaping and Concept of Oversampled Converters (ADC and DAC)	2
14	Time Based ADC for sub-1V Nanometer CMOS	2
15.	Case Study: ADC specification, topology, and design for Direct Conversion RF Receiver	3
16.	Case Study: ADC specification, topology, and design for Sensor Interface	2
	Total	**40**