

EC423: Multi-rate Signal Processing

Details of course:-

Course Title	Course Structure			Pre-Requisite
	L	T	P	
Multi-rate Signal Processing	3	0	2	Signals and Systems, and Digital Signal Processing.

Course Objective: To understand the fundamentals of multi-rate signal processing and its applications. To understand the concepts of filter banks and its applications.

Course Outcomes:

CO1: Describe the fundamentals of multirate signal processing and its applications.

CO2: Explain the theory of sampling rate conversion and develop methods for decimating, interpolating with polyphase implementations.

CO3: Analyze multirate filter banks in terms of theoretical and practical aspects of multirate signal processing.

CO4: Design perfect reconstruction and near perfect reconstruction filter bank.

CO5: Demonstrate multirate Signal processing-based DSP systems.

S. No.	Content	Contact Hours
Unit 1	Introduction, Overview of Sampling and Reconstruction, Review Discrete-Time Systems, digital filters, Oversampling techniques, DT processing of continuous time signals.	6
Unit 2	Fundamentals of Multi-rate Systems, Basic building blocks – Up sampling, down sampling, aliasing, Mathematical framework for sampling rate change, Sampling rate change and filtering, fractional sampling rate change.	8
Unit 3	Interconnection of multi-rate DSP blocks, Multiplexer and Demultiplexer functionality, Polyphase decomposition, Noble Identities, efficient implementation of sampling rate conversion, Applications of Multi-rate DSP - DFT-based Filter banks, Interpolated FIR filter design, Cascaded-Integrator-Comb (CIC) - filters, Trans multiplexer.	10
Unit 4	Signal impairments - Aliasing, Magnitude distortion, Phase distortion, Aliasing cancellation, All pass filters, properties, application in two channel filter banks, Half-band filters, Power	10

	complementary filter pairs, Perfect reconstruction (PR) QMF Bank, Tree structured filter banks, Paraunitary PR Filter Banks, Quantization Effects, Cosine Modulated filter banks.	
Unit 5	Application of Multirate DSP – Delta Sigma A/D conversion, Introduction to wavelets and M-channel perfect reconstruction filter banks.	6
Total		42

Books: -

S. No	Name of Books/Authors/Publisher
1	Multirate Systems and Filter Banks/P. P. Vaidyanathan/Prentice Hall, PTR, 1993.
2	Digital Signal Processing: A computer-based approach/Sanjit K. Mitra/McGraw Hill, 1998.
3	Multirate Digital Signal Processing/N. J. Fliege/John Wiley, 1999.
4	Multirate Signal Processing for Communication Systems/Fredric J. Harris/Prentice Hall, 2004.