| EC-406C | ADVANCED DIGITAL SIGNAL PROCESSING ( ELECTIVE - IV ) | L | T | P | C |
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**COURSE OBJECTIVES:**

1. To understand multirate structures, sampling rate converters.
2. To understand multirate filter banks such as two channel QMF banks.
3. To understand different non-parametric techniques for power spectral estimation.
4. To understand various desing techniques and realisation methods of digital filters.
5. To understand different parametric techniques for power spectral estimation.

**COURSE OUTCOMES:**

**After successful completion of the course, the students are able to**

1. design multistage decimator and interpolator.
2. design multirate filter banks.
3. estimate power spectrum using non-parametric techniques.
4. realise digital filters using lattice structures.
5. estimate power spectrum using parametric techniques.

**UNIT I** **(10)**

**Multi Rate Signal Processing :** Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion.

**UNIT II** **(10)**

**Applications of Multi Rate Signal Processing :** Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Sub-band Coding of Speech Signals, Quadrature Mirror Filters, Trans-multiplexers, Over Sampling A/D and D/A Conversion.

**UNIT III** **(10)**

**Non-Parametric Methods of Power Spectral Estimation :** Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman - Tukey methods, Comparison of all Non-Parametric methods

**UNIT IV** **(10)**

**Implementation of Digital Filters :** Introduction to filter structures (IIR & FIR), Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Backward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

**UNIT V** **(10)**

**Parametric Methods of Power Spectrum Estimation :** Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters - Finite word-length effects in FFT algorithms.

**LEARNING RESOURCES:**

**TEXT BOOK(s):**

1. J.G.Proakis & D. G. Manolakis - Digital Signal Processing: Principles, Algorithms & Applications, 4th Ed., Pearson Education Publication.

2. Alan V Oppenheim & R. W Schaffer - Discrete Time Signal Processing, PHI.
3. Emmanuel C. Ifeacher, Barrie. W. Jervis - DSP - A Practical Approach, 2 Ed., Pearson Education.

**REFERENCE BOOK(s):**

1. Tarun Kumar Rawat - Digital Signal Processing, Oxfod University Press, 2015.
2. Multi Rate Systems and Filter Banks - P.P.Vaidyanathan - Pearson Education.
3. Digital Signal Processing - S.Salivahanan, A.Vallavaraj, C.Gnanapriya, 2000,TMH

**WEB RESOURCES:**

http://nptel.iitm.ac.in/courses/