# FACULTY OF ENGINEERING & TECHNOLOGY

## First Year Master of Engineering

## Semester - I

**Course Code:    102430103**

**Course Title:    Advanced Digital Signal Processing**

**Type of Course:    Program Elective - I**

**Course Objectives:** Students of ME in Signal Processing and communication shall know the fundamentals and applications of digital FIR and IIR filters, predictive and adaptive filters and Multirate signal processing.  They are expected to design DSP algorithms for real time applications.

**Teaching & Examination Scheme:**

| Contact hours per week | | | Course Credits | Examination Marks (Maximum / Passing) | | | | |
|---|---|---|---|---|---|---|---|---|
| Lecture | Tutorial | Practical | | Internal | | External | | Total |
| | | | | Theory | J/V/P* | Theory | J/V/P* | |
| 3 | 0 | 2 | 4 | 30/15 | 20/10 | 70/35 | 30/15 | 150/75 |

\* **J**: Jury; **V**: Viva; **P**: Practical

**Detailed Syllabus:**

| Sr. | Contents | Hours |
|---|---|---|
| 1 | Implementation of  Discrete Time Systems:Structures for IIR systems:  Direct form structures, signal flow graphs and transposed structures, cascade form structures, parallel form structures, Lattice structures and lattice-ladder structures, Structures for FIR systems: Direct form structures, cascade form structures,  Frequency sampling structures and Lattice structures | 06 |
| 2 | Design of IIR filters:Design of IIR filters by approximation of derivatives, impulse invariant transformations and bilinear transformation method, Design of low pass Butterworth filter and Chebyshev filters, Elliptic filters | 09 |
| 3 | Design of FIR filters:Design techniques for FIR filters, Symmetric and anti-symmetric FIR filters, Design of linear phase FIR filters using Windows, Design of linear phase FIR filters using frequency sampling technique. | 09 |
| 4 | Multirate Signal Processing:Introduction to sampling, up sampling and down sampling, Decimation, Interpolation and sampling rate conversion by rational factor, Multistage implementation of sampling rate conversion, Sampling rate conversion by an arbitrary factor, Applications of multi rate signal processing | 09 |
| 5 | Adaptive Filters: Adaptive direct form FIR filter- The LMS algorithm, Adaptive direct from filter – The RLS algorithm, Adaptive Lattice-ladder filters, Applications of adaptive filters | 09 |

**Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):**

| Distribution of Theory Marks | | | | | | R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create |
|---|---|---|---|---|---|---|
| **R** | **U** | **A** | **N** | **E** | **C** | |
| **20%** | **40%** | **10%** | **10%** | **10%** | **10%** | |

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Reference Books:**

| | |
|---|---|
| **1** | J.G.Proakis and D.G.Manolakis, "Digital signal processing: Principles, Algorithm and Applications", 4th Edition, Prentice Hall, 2007 |
| **2** | Li Tian "Digital Signal Processing Fundamentals and Applications" Elsevier 2nd Edition. |
| **3** | Anand Kumar "Digital Signal Processing" Prentice Hall India. |
| **4** | S.K. Mitra, "Digital Signal Processing: A computer based approach" TMH, 2001 |

**Course Outcomes (CO):**

| Sr. | Course Outcome Statements | %weightage |
|---|---|---|
| **CO-1** | Realize the filters in form of structures | **20** |
| **CO-2** | Design digital IIR filters. | **20** |
| **CO-3** | Design digital FIR filters. | **20** |
| **CO-4** | Understand multirate signal processing | **20** |
| **CO-5** | Understand the theory of adaptive filers | **20** |

**List of Practical / Tutorials:**

| | |
|---|---|
| 1 | Basic signal representation and perform convolution of two sequences |
| 2 | Implement direct form-I and direct form – II IIR filters |
| 3 | Implement cascade and parallel form of IIR filters |
| 4 | Design of IIR filters using approximation of derivatives, impulse invariant transformations and bilinear transformation method |
| 5 | Design of Butterworth and Chebyshev filters |
| 6 | Design of FIR filters using various windows. |
| 7 | Implementation of Up sampling and down sampling |
| 8 | Implementation of sampling rate conversion by an arbitrary factor |
| 9 | Study of LMS algorithm |
| 10 | Study of RLS algorithm |

| **Supplementary learning Material:** | |
|---|---|
| 1 | SCILAB |
| 2 | www.nptel.ac.in |

| **Curriculum Revision:** | |
|---|---|
| Version: | **1** |
| Drafted on (Month-Year): | Apr-20 |
| Last Reviewed on (Month-Year): | Jul-20 |
| Next Review on (Month-Year): | Apr-22 |