# Scheme of Teaching and Examination

**M.TECH. - SIGNAL PROCESSING**

## I Semester

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject Code</th>
<th>Name of the Subject</th>
<th>Teaching hours/week</th>
<th>Durations of Exam in Hours</th>
<th>Marks for</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Tutorial</td>
<td>I.A.</td>
</tr>
<tr>
<td>10LSP11</td>
<td>10EC094</td>
<td>DSP Algorithm &amp; Architecture</td>
<td>4</td>
<td>2</td>
<td>-</td>
<td>3</td>
</tr>
<tr>
<td>10LSP12</td>
<td>10EC076</td>
<td>Statistical Signal Processing</td>
<td>4</td>
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<tr>
<td>10LSP13</td>
<td>10EC075</td>
<td>Audio and Speech Processing</td>
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<tr>
<td>10LSP14</td>
<td>10EC046</td>
<td>Linear Algebra</td>
<td>4</td>
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<tr>
<td>10LSP15</td>
<td>10ECxxx</td>
<td>Elective-1 (10LSP15x)</td>
<td>4</td>
<td>-</td>
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<tr>
<td>10LSP16</td>
<td>10EC911</td>
<td>Mini project &amp; Seminar</td>
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<td>3</td>
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Total 20 07 06 15 300 500 800

Practical will be evaluated 25 marks and internal assessment for 25 marks. Lab journals should be maintained.

Assignments/seminar will be evaluated for 25 marks and internal assessment for 25 marks. Record of Assignments/seminar should be maintained.

Mini project should be done individually and is assessed for 25 marks. Seminar on Miniproject will be assessed for 25 marks.

## Elective – I

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>10LSP151</td>
<td>10EC087</td>
<td>CAD for Signal Processing</td>
</tr>
<tr>
<td>10LSP153</td>
<td>10EC127</td>
<td>RF MEMS</td>
</tr>
<tr>
<td>10LSP154</td>
<td>10EC017</td>
<td>Biomedical Signal Processing</td>
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## I Semester

**DSP Algorithms & Architecture**

<table>
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<th>Subject Code</th>
<th>IA Marks</th>
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<tr>
<td>10EC094</td>
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<table>
<thead>
<tr>
<th>No. of Lecture Hours/week</th>
<th>Exam Hours</th>
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<td>04</td>
<td>03</td>
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<table>
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<tr>
<th>Total no. of Lecture Hours</th>
<th>Exam Marks</th>
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<tbody>
<tr>
<td>52</td>
<td>100</td>
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</table>

Introduction to Generic DSP’s, Performance and Structural limitations.

Measures and Structures for enhancing performance.

Filter structures, Transform structures, Data Flow and Control flow issues. Array processing approaches to DSP solutions.

Some modern DSP algorithms (audio, video and multimedia) and development of new computational and arithmetic building blocks.

Architecture development for some Compression and Coding Algorithms.

Reference to some standards and development of Architecture based implementation of these.

**Referene Books:**


Signal Modeling: Least squares method, Padé approximation, Prony's method, finite data records, stochastic models, Levinson-Durbin recursion; Schur recursion; Levinson recursion.


Array Processing: Array fundamentals, beam-forming, optimum array processing, performance considerations, adaptive beam-forming, linearly constrained minimum-variance beam-formers, side-lobe cancellers, space-time adaptive processing.

REFERENCE BOOKS:


Time Domain Models For Speech Processing: Time dependent processing of speech, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using energy & zero crossings, Pitch period estimation, Short time autocorrelation function, Short time average magnitude difference function, Pitch period estimation using autocorrelation function, Median smoothing.


Homomorphic Speech Processing: Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder.

Linear Predictive Coding of Speech: Basic principles of linear predictive analysis, Solution of LPC equations, Prediction error signal, Frequency domain interpretation, Relation between the various speech parameters, Synthesis of speech from linear predictive parameters, Applications.


Automatic Speech Recognition: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks.

Audio Processing: Auditory perception and psychoacoustics - Masking, frequency and loudness perception, spatial perception, Digital Audio, Audio Coding - High quality, low-bit-rate audio coding standards, MPEG, AC-3, Multichannel audio - Stereo, 3D binaural and Multichannel surround sound.

REFERENCE BOOKS:


LINEAR ALGEBRA

<table>
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<td>10EC046</td>
<td>50</td>
<td>03</td>
<td>100</td>
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</table>

Linear Equations: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization.

Vector Spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces.

Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functionals; transpose of a linear transformation.

Canonical Forms: Characteristic values; annihilating polynomials; invariant subspaces; direct-sum decompositions; invariant direct sums; primary decomposition theorem; cyclic bases; Jordan canonical form. Iterative estimates of characteristic values.

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; unitary operators.

Symmetric Matrices and Quadratic Forms: Digitalization; quadratic forms; constrained optimization; singular value decomposition.

REFERENCE BOOKS:


ELECTIVE - I

CAD FOR SIGNAL PROCESSING

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<tr>
<td>10EC087</td>
<td>50</td>
<td>04</td>
<td>03</td>
<td>52</td>
<td>100</td>
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**Digital Signal Processing of Continues Time Signals:** Sampling process in time domain, effect of sampling in frequency domain. Among low pass filter, A to D and D to A conversions. Realization of FIR, IIR filter, Design of digital filter and simulation of IIR, FIR filters.

**Multirate Digital Signal Processing:** Sampling rate alteration, devices, decimator and Interpolator, design and implementation. Design of filter banks, design of Nyquist filters, Perfect reconstruction, quadratic mirror filter, power symmetric FIR filters. DTWT basis functions for multilevel decompositions.

**Basic Graphical Technique:** Estimation and Coding, Monte – carlo method, fundamental concepts, applications to communication systems, Mante- Carlo integration.

**Application In Communication And Adaptive Filtering:** LMS algorithms, system identifications, suppression of narrow band interference in a mid band signal. Adaptive line enhancement, adaptive channel equalization. PCM, DPCM, DM of speech binary digital communication. Spread spectrum communication.

**Digital Image Processing using MAT Lab:** Digital Image representation, reducing images, displaying images, writing images, data classes, image types, converting between data classes and image types, array indexing, intensity transformation and special filtering. 2D DFT filtering in frequency domain.

**REFERENCE BOOKS:**


RF MEMS

<table>
<thead>
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<tbody>
<tr>
<td>10EC127</td>
<td>50</td>
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</table>
No. of Lecture Hours /week : 04
Total no. of Lecture Hours : 52
Exam Hours : 03
Exam Marks : 100

**Review – Introduction to MEMS.** Fabrication for MEMS, MEMS transducers and Actuators. Microsensing for MEMS, Materials for MEMS.

**MEMS materials and fabrication techniques** – Metals, Semiconductors, thin films, Materials for Polymer MEMS, Bulk Machining for silicon based MEMS, Surface machining for Silicon based MEMS, Micro Stereo Lithography for Polymer MEMS.

**RF MEMS Switches and micro-relays.** Switch Parameters, Basics of Switching, Switches for RF and microwave Applications, Actuation mechanisms, micro relays and micro actuators, Dynamics of Switch operation, MEMS Switch Design and design considerations. MEMS Inductors and capacitors.

**Micromachined RF Filters and Phase shifters.** RF Filters, Modeling of Mechanical Filters, Micromachanical Filters, SAW filters – Basics, Design considerations. Bulk Acoustic Wave Filters, Micromachined Filters for Millimeter Wave frequencies. Micromachined Phase Shifters, Types and Limitations, MEMS and Ferroelectric Phase shifters, Applications.

**Micromachined transmission lines and components.** Micromachined Transmission Lines – Losses in Transmission lines, coplanar lines, Microshield and membrane supported lines, Microshield components, Micromachined waveguides, directional couplers and mixers, Resonators and Filters.

**Micromachined antennas.** Design, Fabrication and Measurements. Integration and Packaging for RF MEMS. Roles and types of Packages, Flip Chip Techniques, Multichip module packaging and Wafer bonding, Reliability issues and Thermal issues.

**References:**

2. RF MEMS Circuit Design J De Los Santos, Artech House, 2002
INTRODUCTION: Genesis and significance of bioelectric potentials, ECG, EOG, EMG and their monitoring and measurement. Spectral analysis, digital and analog filtering, correlation and estimation techniques, AR / ARMA models, Adaptive Filters.

ECG: Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Baseline wander removal, waveform recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

EEG: evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages,

EMG: wave pattern studies, biofeedback, Zero crossings, Integrated EMG. Time frequency methods and Wavelets in Biomedical Signal Processing

REFERENCE BOOKS: