Faculty of Engineering – Scheme & Syllabi of M.Tech Course in Digital signal processing – implemented with effect from 2010 admission - Orders Issued.

GENERAL AND ACADEMIC BRANCH IV E Section

GAIV/E1/7377/2010 Dated, Calicut University.P.O., 12-11-2010

Read:- 1) U.O. No. GA IV/E1/1894/2003(sub file) dated 02.08.2010.

2) Minutes of the meeting of the Board of Studies in Engineering (PG) held on 13.08.2010. (Item No. 6)

3) Orders of Registrar in charge of Vice Chancellor in the file of even number dated 08.09.2010.

ORDER

As per paper read (1) above, an expert Committee was constituted with the following members (a) Dr. Reena. P. (Member, Board of Studies in Engineering-PG) Assistant Professor (E&C), Government Engineering College, West Hill, Kozhikode. (b) Dr. Sreelekha. G., Assistant Professor, Department of Electronics, National Institute of Technology, Calicut. (c) Smt. Sreelatha. G., Senior Lecturer (E & C), Government Engineering College, West Hill, Kozhikode.

Vide paper read (2) above, the meeting of the Board of Studies in Engineering (PG) held on 13.08.2010 resolved to recommend the syllabus of M.Tech. Digital signal processing for approval.

Considering the urgency of the matter, Registrar in charge of Vice Chancellor has accorded sanction to implement the Scheme & Syllabus of the M.Tech Course in Digital Signal Processing, subject to ratification by Academic Council, vide paper read (3) above.

Sanction is therefore accorded for implementing the appended Scheme & Syllabus of M.Tech Course in Digital Signal Processing with effect from 2010 admission.

Orders are issued accordingly.

Sd/-

DEPUTY REGISTRAR (G&A IV)

To

The Principals of all Engineering Colleges, Where M.Tech is offered.

Copy to:

PS to VC / PA to Registrar/ PA to CE/Ex. Sn./EG/ Chairman Board of Studies in Engineering (UG)/ Dean, Faculty of Engineering/SA (with a request to upload in the University website)/ SF / FC.

Forwarded/By

Sd/-
UNIVERSITY OF CALICUT

M. Tech. Degree Course
DIGITAL SIGNAL PROCESSING
(ELECTRONICS ENGINEERING)

Curricula, Scheme of Examinations and Syllabi
(With effect from 2010 admissions)
### SCHEME OF EXAMINATIONS

#### Semester I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Subject</th>
<th>Hours/week</th>
<th>Marks</th>
<th>Total marks</th>
<th>Sem-end exam duration - Hrs</th>
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**Elective I**

DSP 10 105A: Digital Filter Design & Applications
DSP 10 105B: DSP System Design
DSP 10 105C: Image Processing
DSP 10 105D: Digital Communication Techniques
DSP 10 105E: Optimisation Techniques

#### Semester – II
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**Elective II**

DSP 10 204A: Signal Compression Techniques  
DSP 10 204B: Array Signal Processing  
DSP 10 204C: Wireless Communications  
DSP 10 204D: Information Theory & Data Encryption

**Elective III**

DSP 10 205A: Transform Theory  
DSP 10 205B: Spectral Analysis Techniques  
DSP 10 205C: Secure Communication  
DSP 10 205D: Graph Theory

**Semester III**

<table>
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<tr>
<th>Course Code</th>
<th>Subject</th>
<th>Hours/week</th>
<th>Marks</th>
<th>Total</th>
<th>Sem-end exam duration - Hrs</th>
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NB: The student has to undertake the departmental work assigned by HOD

*EC – Evaluation Committee

**Elective IV**

DSP 10 301A: Speech and Audio Processing
DSP 10 301B: Biomedical Signal Processing
DSP 10 301C: Theory of Error Control Coding
DSP 10 301D: Space Time Coding and MIMO Systems

**Elective V**

DSP 10 302A: VLSI Structure for DSP
DSP 10 302B: Pattern Recognition and Analysis
DSP 10 302C Spread Spectrum & CDMA systems
DSP 10 302D: Markov modeling and Queuing Theory

**Semester IV**

<table>
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<tr>
<th>Course Code</th>
<th>Subject</th>
<th>Hours per week</th>
<th>Internal Marks</th>
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<td>600</td>
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NB: The student has to undertake the departmental work assigned by HOD
Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:

This course provides further studies on linear algebra which has wide areas of application. Also it gives a brief description of the concepts and results in matrices and power series that may be useful in engineering.

Module I: (13 Hours)


Module I: (13 Hours)


Module II: (13 Hours)


Module III: (13 Hours)


References:

1. G. F. Simmons,Topology and Modern Analysis, McGraw Hill
2. Frazier, Michael W. An Introduction to Wavelets Through Linear Algebra, Springer Publications

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks
Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 102: DSP ALGORITHMS AND ARCHITECTURE

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
- The evolving field of ASIC design enables the customized design of DSP algorithms on dedicated chips. This paper introduces systematic approaches for mapping algorithms to VLSI architectures. It deals with representation of DSP algorithms, various techniques to optimize these architectures for various parameters such as computation time, hardware, space and power consumption. It also introduces fast DSP algorithms for efficient hardware implementation.
Module I: (14 hours)

DSP Algorithm Design

Module II: (12 hours)

Circuits and DSP Architecture Design
Fast filtering algorithms (Winograd's, FFT, short-length FIR), retiming and pipelining, block processing, folding, distributed arithmetic architectures, VLSI performance measures (area, power, and speed), structural modeling in VHDL. Analog signal processing for fast operation. Impact of nonideal characteristics of analog functional blocks on the system performance.

Module III: (14 hours)

DSP Module Synthesis

Module IV: (12 hours)

Parallel algorithms and their dependence
Applications to some common DSP algorithms. System timing using the scheduling vector. Projection of the dependence graph using a projection direction. The delay operator and z-transform techniques for mapping DSP algorithms onto processor arrays. Algebraic technique for mapping algorithms. The computation domain. The dependence matrix of a variable. The scheduling and projection functions. Data broadcast and pipelining Applications using common DSP algorithms.

References:

3. Uwe Meyer-Baese, Digital Signal Processing with Field Programmable Gate Array, Springer-Verlag 2001

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
DSP 10 103: RANDOM PROCESSES AND APPLICATIONS

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
- To introduce the fundamentals of probability theory and random processes and illustrate these concepts with engineering applications. This course will present the basic principles of random variables and random processes needed in applications such as signal processing, digital communications, speech processing, data modeling, etc. MATLAB will be used as a software tool for bringing probability theory and real-world applications closer together.

Module 1: (13 hours)
Probability Theory & Random variables
Probability axioms, conditional probability, discrete and continuous random variables, cumulative distribution function (CDF), probability mass function (PMF), probability density function (PDF), conditional PMF/PDF, expected value, variance, functions of a random variable, expected value of the derived random variable, multiple random variables, joint CDF/PMF/PDF, functions of multiple random variables, multiple functions of multiple random variables, independent/uncorrelated random variables, sums of random variables, moment generating function, random sums of random variables. The sample mean, laws of large numbers, central limit theorem, convergence of sequence of random variables.

Module 2: (13 hours)
Introduction to random processes, specification of random processes, $n$th order joint PDFs, independent increments, stationary increments, Markov property, Markov process and martingales, Gaussian process, Poisson process and Brownian motion, Mean and correlation of random processes, stationary, wide sense stationary, ergodic processes, Mean-square continuity, mean-square derivatives.

Module 3: (14 hours)
Random processes as inputs to linear time invariant systems: power spectral density, Gaussian processes as inputs to LTI systems, white Gaussian noise. Discrete-time Markov chains: state and n-step transition probabilities, Chapman-Kolmogorov equations, first passage probabilities, classification of states, limiting state probabilities.

**Module 4: (12 hours)**
Series representation of random process: Fourier series, Karhunen-Loeve expansion, Mercer's theorem, sampled band-limited processes, filtering using series representation

**Reference:**

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks
DSP 10 104: MULTIRATE SIGNAL PROCESSING

Teaching scheme: 4
3 hours lecture & 1 hour tutorial per week

Objective:
- The course focuses on multirate signal processing which is the basic to modern signal processing. Topics include multirate signal processing material such as decimation, interpolation, filter banks, polyphase filtering, advanced filtering structures and nonuniform sampling and the cosine modulated filter banks.

Module 1: (14 hours)
Fundamentals of Multirate Theory
The sampling theorem: sampling at subnyquist rate - Basic Formulations and schemes.
Basic Multirate operations: Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Polyphase representation
Maximally decimated filter banks: Polyphase representation - Errors in the QMF bank- Perfect reconstruction (PR) QMF Bank - Design of an alias free QMF Bank

Module 2: (12hours)
M-channel perfect reconstruction filter banks
Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Polyphase representation- perfect reconstruction systems

Module 3: (14 Hours)
Perfect reconstruction (PR) filter banks
Paraunitary PR Filter Banks- Filter Bank Properties induced by paraunitarity- Two channel FIR paraunitary QMF Bank- Linear phase PR Filter banks- Necessary conditions for Linear phase property- Quantization Effects: -Types of quantization effects in filter banks. - coefficient sensitivity effects, dynamic range and scaling.

Module 4: (12Hours)
Cosine Modulated filter banks
Cosine Modulated pseudo QMF Bank- Alas cancellation- phase - Phase distortion- Closed form expression- Polyphase structure- PR Systems

Text Books

Reference Books
Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 105A: DIGITAL FILTER DESIGN & APPLICATIONS

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Objective:
This course includes an in-depth treatment of the topic digital filter design. It will strengthen the student's understanding of the foundations of DSP, filter design aspects in view of major application areas. It also covers the implementation issues such as finite word length effects which is a very important aspect of digital processing. It also covers the adaptive filter design concepts and spectral estimation methods which are used extensively in today's engineering applications.

Module I (12 hours)
LTI Systems & Transform

LTI systems as frequency selective filters. Invertibility of LTI systems. Minimum phase, maximum phase and mixed phase systems. All-pass filters. Design of digital filters by placement of poles and zeros. DFT as a linear transformation. Linear filtering methods based on DFT. Frequency analysis of signals using DFT. Discrete cosine transform.

Module II (14 hours)
Design of FIR filters

Introduction-Specifications-Coefficient calculation methods-Window, Optimal and Frequency sampling methods-Comparison of different methods-Realization structures-Finite word length effects-Implementation techniques-Application examples. FIR filter design with Matlab or Octave. Implementation of FIR filtering in general purpose digital signal processors.

Module III (14 hours)
Design of IIR filter:


Module IV (12 hours)
Adaptive Digital Filters:


Power Spectrum Estimation:


Reference:


Reading:

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 105B: DSP System Design

Teaching scheme:
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:

The aim of the paper is to introduce to the students the architectural features as well as the programming aspects of the latest DSPs available in the market. The students at the end of the course should be able to choose the appropriate processor for a given application environment and should be in a position to design stand alone systems based on DSPs, given a set of specifications.

Module 1 (14 hours) : Introduction to a popular DSP from Texas Instruments: CPU Architecture - CPU Data Paths and Control - Timers - Internal Data/Program Memory - External Memory Interface - Programming - Instructions Set and Addressing Modes - Code Composer Studio - Code Generation Tools - Code Composer Studio Debug tools – Simulator

Module 2 (16 hours) : Sharc Digital Signal Processor: A popular DSP from Analog Devices - Sharc/ Tiger Sharc/ Blackfin (one of them) - Architecture - IOP Registers - Peripherals -
Synchronous Serial Port - Interrupts - Internal/External/Multiprocessor Memory Space - Multiprocessing - Host Interface - Link Ports.

**Module 3: (16 hours)**

**Module 4 (6 hours)**
Current trends: Current trend in Digital Signal Processor or DSP Controller - Architecture and their applications.

**Text Books:**

**References:**

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks
Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 105C: IMAGE PROCESSING

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
- Visual information plays an important role in almost all areas of our life. This course introduces the fundamentals of digital image processing. It emphasizes general principles of image processing, rather than specific applications. It covers topics such as image representation, color representations, sampling and quantization, point operations, linear image filtering and correlation, transforms and subband decompositions, and nonlinear filtering, contrast and color enhancement, dithering, and image restoration and compression. It also introduces the basic concepts of video processing.

Module 1: (14 hours)

Module 2: (14 hours)

Module 3: (14 hours)

Module 4: (10 hours)
Video Processing: Representation of Digital Video, Spatio-temporal sampling; Motion Estimation; Video Filtering; Video Compression, Video coding standards.
Texts/References

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
Objective:

- This course introduces the theoretical background needed to understand digital communication techniques. The main emphasis is on digital transmission via additive white Gaussian noise channels, synchronization aspects of communication systems and communication over band limited channels.

Module 1: (12 hours)
Random Variables and Processes: Review of Random variable: Moment generating function, Chernoff bound, Markov's inequality, Chebyshev’s inequality, Central Limit Theorem, Chi square, Rayleigh and Rician distributions, Correlation, Covariance matrix - Stationary processes, wide sense stationary processes, ergodic process, cross correlation and autocorrelation functions-Gaussian process

Module 2: (16 hours)
Communication over Additive Gaussian Noise Channels
Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels. Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver, Matched filter receiver and error probabilities. Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals- Probability of error for envelope detection of M-ary Orthogonal signals. Optimum waveform receiver for coloured Gaussian noise channels- Karhunen Loeve expansion approach, whitening.

Module 3: (14 hours)
Synchronization in Communication Systems

Module 4: (10 hours)
Communication over Band limited Channels

Text Book:

Reference Books:
Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 105(E): OPTIMISATION TECHNIQUES

Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:

The aim of this course is to expose students to various deterministic optimization tools and techniques. The course generally covers topics such as: an overview of mathematical modelling, linear and non-linear programming and various
constrained & unconstrained optimization techniques which will be useful for engineering applications.

Module I: (12Hours)

Module II: (14 hours)

Module III: (14 hours)

Module IV: (12 Hours)
Constrained optimization: Lagrangian method - Sufficiency conditions - Kuhn-Tucker optimality conditions- Rate of convergence - Engineering applications Quadratic programming problems-Convex programming problems.

References:
1. David G Luenberger, Linear and Non Linear Programming, 2nd Ed, Addison-Wesley.

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks
Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 106(P): DSP SYSTEMS LAB

Hours per week: 2 hours practical
Credits: 2

Development Environment
Familiarization to DSP project development stages. Study of the features of the processor used. Development environment.

High Level Language Project Development
Developing projects in a high level language and cross-compiling. Familiarization with the debugging facilities of the IDE. Profiling. Optimizations in C.

Assembly Optimizations

Memory Map
Understand the memory map of the processor. Optimizations by using internal memory.

Real Time Processing
Using the ADC and DAC for signal acquisition and play back. Real time filtering.

Mini Project (Compulsory)
Student has to do a mini project on a topic approved by a 3 member committee and submit two copies of project report and an assessment will be conducted by the committee.

Reference
1. Jones D. DSP Laboratory with TI TMS320C54x [Connexions Web site]. January 22, 2004. Available at: http://cnx.rice.edu/content/col10078/1.2/

2. The manuals of the IDE and Processor being used.

**Internal continuous assessment: 100 marks**

Internal continuous assessment will be as follows.

Continuous Evaluation (Assessment of individual Experiments): 30
Mini Project (Demonstration, Report & Viva): 30
End Semester Exam (Practical Test & Viva): 40
Objective:

- To assess the debating capability of the student to present a technical topic. Also to impart training to a student to face audience and present his/her ideas and thus creating self esteem and courage that are essential for an engineer.

Individual students are required to choose a topic of their interest preferably from outside the M.Tech syllabus and give a seminar on that topic about 45 minutes. A committee consisting of at least three faculty members shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a write up of the seminar topic. One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other will be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation.

**Internal Continuous Assessment (Maximum Marks-100)**

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SECOND SEMESTER

DSP 10 201: WAVELET THEORY

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:

- To impart the importance of wavelets
- To understand the fundamentals of wavelet theory
- To familiarise with the most commonly used wavelets
- Selection procedure of wavelets
- To familiarise with the construction of different types of wavelets

Module I: (13 hours)
Fourier and Sampling Theory: Generalized Fourier theory, Fourier transform, Short-time (windowed) Fourier transform, Time-frequency analysis, Fundamental notions of the theory of sampling.

Theory of Frames: Bases, Resolution of unity, Definition of frames, Geometrical considerations and the general notion of a frame, Frame projector, Example – windowed Fourier frames.

Module II: (13 hours)
Wavelets: The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT).

The multiresolution analysis (MRA) of \( L^2(R) \): The MRA axioms, Construction of an MRA from scaling functions - The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality.

Module III: (11 hours)
Regularity and selection of wavelets: Smoothness and approximation order - Analysis in Soboleve space, Criteria for wavelet selection with examples.

Module IV: (15 hours)
Construction of wavelets: Splines, Cardinal B-spline MRA, Subband filtering schemes, Compactly supported orthonormal wavelet bases.

Wavelet transform: Wavelet decomposition and reconstruction of functions in \( L^2(R) \). Fast wavelet transform algorithms – Relation to filter banks, Wavelet packets – Representation of functions, Selection of basis.

Construction of wavelets: Biorthogonality and biorthogonal basis, Biorthogonal system of wavelets - construction, The Lifting scheme.

Text books:

Reference books:

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 202: ADAPTIVE SIGNAL PROCESSING

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
- To introduce adaptive systems
- To understand the filter design related to adaptive signal processing
- To introduce different algorithms to implement adaptive signal processing
- Application of adaptive signal processing

Module 1: (13 hours)

Module 2: (13 hours)

**Module 3: (12 hours)**
LMS algorithm convergence of weight vector-LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random-search algorithms - lattice structure - adaptive filters with orthogonal signals

**Module 4: (14 hours)**
Applications-adaptive modeling and system identification-adaptive modeling for multipath communication channel, geophysical exploration, FIR digital filter synthesis, inverse adaptive modeling, equalization, and deconvolution-adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis

**References:**

**Internal continuous assessment: 100 marks**
Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**
**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
Question 7: 20 marks
Question 8: 20 marks
DSP 10 203: ESTIMATION AND DETECTION THEORY

Teaching scheme: Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
- To introduce Detection theory and impart knowledge in both single observation and multiple observations.
- To introduce the need of Estimation theory and different methods for estimation
- To understand the different properties of estimators
- To introduce state estimation

Module 1: (12 hours)
Detection theory: Binary decisions - Single observation
Maximum likelihood decision criterion; Neymann-Pearson criterion; Probability of error criterion; Bayes risk criterion; Minimax criterion; Robust detection; Receiver operating characteristics.

Module 2: (12 hours)
Detection theory: Binary decisions - Multiple observations
Vector observations; The general Gaussian problem; Waveform observation in additive Gaussian noise; The integrating optimum receiver; Matched filter receiver.

Module 3: (14 hours)
Estimation theory
a) Methods: Maximum likelihood estimation; Bayes cost method Bayes estimation criterion - Mean square error criterion; Uniform cost function; absolute value cost function; Linear minimum variance - Least squares method; Estimation in the presence of Gaussian noise - Linear observation; Non-linear estimation.
b) Properties of estimators: Bias, Efficiency, Cramer Rao bound Assymptotic properties; Sensitivity and error analysis

Module 4: (14 hours)
a) State estimation: Prediction; Kalman filter.
b) **Sufficient statistics and statistical estimation of parameters**: Concept of sufficient statistics; Exponential families of distributions; Exponential families and Maximum likelihood estimation; Uniformly minimum variance unbiased estimation.

**References:**

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks

**Module III**
- Question 5: 20 marks
- Question 6: 20 marks

**Module IV**
- Question 7: 20 marks
- Question 8: 20 marks
DSP 10 204A: SIGNAL COMPRESSION TECHNIQUES

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:

- To familiarise with different coding techniques.
- To introduce the concept of rate distortion theory.
- To introduce different types of transforms
- To familiarise with different data compression standards

Module 1: (13 hours)

Module II: (13 hours)
Rate distortion theory: Rate distortion function R(D),Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source, Rate distortion theorem, Converse of the Rate distortion theorem, Quantization - Uniform & Non-uniform - optimal and adaptive quantization, vector quantization and structures for VQ, Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes

Module III: (13 hours)
Mathematical Preliminaries for Transforms, Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform, Lapped transforms - Transform coding - Subband coding - Wavelet Based Compression - Analysis/Synthesis Schemes

Module IV: (13 hours)

Text books

Reference books

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks

**Module III**
- Question 5: 20 marks
- Question 6: 20 marks

**Module IV**
- Question 7: 20 marks
- Question 8: 20 marks

**DSP 10 204B: ARRAY SIGNAL PROCESSING**

**Teaching scheme:**
3 hours lecture & 1 hour tutorial per week

**Credits:** 4

**Objective:**
- To familiarise with spatial signals.
- To introduce the concept behind sensor arrays
- To familiarise with spatial frequency
- To introduce the different methods for direction of arrival estimation

**Module I: (13 hours)**
Spatial Signals: Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals.

Module II: (13 hours)

Module III: (13 hours)

Module IV: (13 hours)

Reference

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 204C: WIRELESS COMMUNICATIONS

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
- To familiarise with different channel models
- To impart knowledge in the concept of fading and diversity.
- To familiarise with different techniques in cellular communication
- To introduce the concept of spread spectrum and CDMA
- To impart knowledge in fading channel capacity in different systems

Module 1: (13 hours)

Module 2: (10 hours)

Module 3: (14 hours)

Module 4: (15 hours)

Fading Channel Capacity: Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels- Multiple Input Multiple output (MIMO) systems- Narrow band multiple antenna system model- Parallel Decomposition of MIMO Channels- Capacity of MIMO Channels. Cellular Wireless Communication Standards - Second generation cellular systems: GSM specifications and Air Interface - specifications, IS 95 CDMA - 3G systems:

UMTS & CDMA 2000 standards and specifications

Text Books
2. Simon Haykin and Michael Moher, “ Modern Wireless Communications”, Person Education.

Reference Books

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 204D: INFORMATION THEORY & DATA ENCRYPTION

Teaching scheme:  Credits: 4
3 hours lecture & 1 hour tutorial per week

Objective:
- To introduce the different techniques in cryptography
- To impart knowledge in the field of information hiding. Introduced the different techniques and their applications
- To introduce the concept of hiding in 1D signals, 2D signals and in video signals.
- To introduce the concept of steganalysis.

Module I: (12 hours)

Module II: (14 hours)


Module III: (14 hours)

Hiding in 1D signals: Time and transform techniques-hiding in Audio, biomedical signals, HAS Adaptive techniques.

Hiding in 2D signals: Spatial and transform techniques-hiding in images, ROI images, HVS Adaptive techniques.

Hiding in video: Temporal and transform domain techniques, Bandwidth requirements.

Module IV: (12 hours)

Steganalysis: Statistical Methods, HVS based methods, SVM method, Detection theoretic approach.

Quality evaluation: Benchmarks, Stirmark, Certimark, Checkmark, standard graphs for evaluation.

Reference


**Reading**

1. Ira S Moskowits, *Proceedings, 4th international workshop*, IH 2001, Pitts burg, USA April 2001 Eds:


**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**

Answer any 5 questions by choosing at least one question from each module.

**Module I**

Question 1: 20 marks  
Question 2: 20 marks

**Module II**

Question 3: 20 marks  
Question 4: 20 marks

**Module III**

Question 5: 20 marks  
Question 6: 20 marks

**Module IV**

Question 7: 20 marks  
Question 8: 20 marks

DSP 10 205A: TRANSFORM THEORY

**Teaching scheme:**

3 hours lecture & 1 hour tutorial per week
Objective:
- To impart a thorough knowledge in Discrete Fourier Transform and the Karhunen-Loeve transform

Module I (11 hours)

Module II (14 hours)

Module III (15 hours)
*The Fourier Transform*: $L^2(\mathbb{R})$ and Approximate Identities. The Fourier Transform on $\mathbb{R}$.

Module IV (12 hours)

Reference

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 205B: SPECTRUM ANALYSIS TECHNIQUES

Teaching scheme:  
3 hours lecture & 1 hour tutorial per week

Objective:
- To introduce Power spectral density
- To impart knowledge in different methods of PSD estimation both in Non-parametric & parametric methods
- To introduce the filter bank methods

Module I: (10 hours)
Power Spectral Density: Energy spectral density of deterministic signals, Power spectral density of random signals, Properties of PSD

Module II: (13 hours)
PSD Estimation - Non-parametric methods: Estimation of PSD from finite data, Non-parametric methods: Periodogram properties, bias and variance analysis, Blackman-Tuckey method, Window design considerations, time-bandwidth product and resolution - variance trade-offs in window design, Refined periodogram methods: Bartlet method, Welch method.

Module III: (17 hours)
least square method, Burg method for AR parameter estimation.

Parametric method for line spectra: Models of sinusoidal signals in noise, Non-linear least squares method, Higher order Yule-Walker method, MUSIC and Pisayenko methods, Min-norm method, ESPIRIT method

Module IV: (12 hours)

Filterbank methods: Filterbank interpretation of periodogram, Slepia base-band filters, refined filterbank method for higher resolution spectral analysis, Capon method, Introduction to higher order spectra.

References
1. Introduction to Spectral Analysis, Stoica, R.L. Moses, Prentice Hall

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 205C: SECURE COMMUNICATION

Teaching scheme:
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
- To introduce the basic concept encryption techniques
- To familiarise with the concept of private key and public key cryptosystems.
- To introduce the concept of Elliptic curves

Module 1: (12 hours)
Rings and fields - Homomorphism- Euclidean domains - Principal Ideal Domains - Unique Factorization Domains -- Field extensions- Splitting fields - Divisibility- Euler theorem - Chinese Remainder Theorem –Primality

Module 2: (13 hours)
Basic encryption techniques - Concept of cryptanalysis - Shannon's theory - Perfect secrecy - Block ciphers - Cryptographic algorithms - Features of DES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions

Module 3: (14 hours)
Private key and Public key cryptosystems - One way functions - Discrete log problem - Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions –Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography

Module 4: (13 hours)
Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity -Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography - Diffie Hellmann key exchange over EC - Elgamal encryption over EC – ECDSA

Text Books

Reference Books
Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
Teaching scheme: 3 hours lecture & 1 hour tutorial per week

Credits: 4

Objective:
- To introduce the different concept in graph theory

Module I: (13 hours)
Introduction to graphs, definitions, subgraphs, paths and cycles, isomorphism, cut vertex, bridge, block, bipartite graph, complement of a graph, vertex and edge connectivity, degree sequence, metric, eccentricity, centre, median.

Module II: (13 hours)
Trees, definitions and properties, rooted trees, trees and sorting, weighted trees and prefix codes, Matrix representation of graphs, Adjacency, Incidence and Distance matrices, Matrix tree theorem, biconnected components and articulation points.

Module III: (12 hours)
Planar graphs, Euler formula, platonic bodies. Hamiltonian graphs, graph colouring and chromatic polynomials, Network flows and max-flow min-cut theorem.

Module IV: (14 hours)
Digraphs, connectivity, acyclic digraphs, tournaments, Algorithms and complexity, Polynomial algorithms and NP completeness, BFS, DFS, Kruskal’s, Prim’s, Dijkstra’s & Floyd’s algorithms.

References:

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
DSP 10 206(P): SIGNAL PROCESSING LAB

Hours per week: Practical 2 hours
Credits: 2

Objective:

• To experiment the concepts introduced in the courses Adaptive Signal Processing and Estimation and Detection Theory

Tools:

1. Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool.
2. DSP Kits – TMS320C6X or AD or equivalent

Suggested Experiments:


Internal Continuous Assessment (Maximum Marks-100):

Regularity - 30 marks
Record - 20 marks
Tests, Viva - 50 marks
THIRD SEMESTER

The student has to credit 2 theory subjects from the two groups of electives listed. The student has to undergo an industrial training of duration one month during the semester break after the semester II and complete that within 15 calendar days from the start of semester III.

DSP 10 301A: SPEECH AND AUDIO PROCESSING

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:

- To study the mechanisms of speech production and various models used for speech processing
- To provide a knowledge of different coding methods used in speech and audio processing

Module 1 (13 hrs)

Module 2 (14 hrs)

Module 3 (13 hrs)

Module 4 (12 hrs)

Reference books:
Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 301B: BIOMEDICAL SIGNAL PROCESSING

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:

- To impart knowledge about the principle of different types of bio-medical signals
- To give ideas about the interpretation of various signals in biomedical applications

Module 1 (10 hrs)
Introduction to Biomedical Signals - Examples of Biomedical signals - ECG, EEG, EMG etc - Tasks in Biomedical Signal Processing - Computer Aided Diagnosis. Origin of bio potentials - Review of linear systems - Fourier Transform and Time Frequency Analysis - (Wavelet) of biomedical signals- Processing of Random & Stochastic signals - spectral
estimation – Properties and effects of noise in biomedical instruments - Filtering in biomedical instruments

**Module 2 (10 hrs)**

**Module 3 (11 hrs)**

**Module 4 (11 hrs)**

**Reference Books:**
4. Semmlow, Marcel Dekker “Biosignal and Biomedical Image Processing”, 2004
5. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier, 2005

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
Question 1: 20 marks
Question 2: 20 marks

**Module II**
Question 3: 20 marks
Question 4: 20 marks

**Module III**
Question 5: 20 marks
Question 6: 20 marks

**Module IV**
DSP 10 301C: THEORY OF ERROR CONTROL CODING

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:

- To give the basic ideas of error control coding
- To impart knowledge about different types of codes used in communication

Module 1: (13 hours)
**Finite Field Arithmetic:** Introduction, Groups- Rings- Fields- Arithmetic of Galois Field- Integer Ring- Polynomial Rings- Polynomials and Euclidean algorithm, primitive elements, Construction and basic properties of Finite Fields- Computations using Galois Field arithmetic- sub fields- Minimal polynomial and conjugates - Vector space - Vector Subspace- Linear independence.

Module 2: (13 hours)
**Linear Block Codes:** Linear Block codes- Properties- Minimum Distance- Error detection and correction- Standard Array and Syndrome decoding- Hamming codes- Perfect and Quasi-perfect codes - Extended codes- Hadamard codes.

Module 3: (12 hours)
**Cyclic Codes:** Basic theory of Cyclic codes- Generator and Parity check matrices - Cyclic encoders- Error detection & correction- decoding of cyclic codes- Cyclic Hamming codes- Binary Golay codes- BCH codes- Decoding of BCH codes-The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes.

Module 4: (14 hours)
Convolutional Codes: Generator matrices and encoding- state, tree and trellis diagram - Transfer function - Maximum Likelihood decoding Hard versus Soft decision decoding - The Viterbi Algorithm- Free distance- Catastrophic encoders.

Soft Decision and Iterative Decoding: Soft decision Viterbi algorithm- Two way APP decoding- Low density parity check codes- Turbo codes - Turbo decoding

Text Books

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 301D: SPACE TIME CODING AND MIMO SYSTEMS

Teaching scheme

3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:

• To give the basic idea of MIMO systems
• To impart knowledge of Space Time Coding

Module 1: (13 hours)
Information theoretic aspects of MIMO: Review of SISO communication - MIMO channel models - Classical i.i.d. and extended channels – Frequency selective and correlated channel models - Capacity of MIMO channels - Ergodic and Outage Capacity - Capacity bounds - Influence of channel properties on capacity.

Module 2: (13 hours)

Module 3: (14 hours)

Module 4: (12 hours)
Space Time Trellis Codes: Diagram - Code construction. Delay diversity as a special case of STTC- Performance Analysis.

Text Books

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks

DSP 10 302A: VLSI STRUCTURE FOR DSP

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Objectives:

- To study the different VLSI structures used for DSP
- To introduce the DSP processors used for different applications
To introduce the various steps in IC fabrication, starting from the raw material to the finished product as well as physical principles involved in these processes

Module I: (13 hours)

Module II: (13 hours)
Parallel FIR filters – discrete time cosine transform – implementation of DCT based on algorithm – architecture transformations – parallel architectures for rank order filters.

Module III: (13 hours)
Scaling and round off noise - round off noise in pipelined IIR filters – round off noise in lattice filters – pipelining of lattice IIR digital filters – low power CMOS lattice IIR filters.

Module IV: (13 hours)
Evolution of programmable DSP processors - DSP processors for mobile and wireless communications -processors for multimedia signal processing - FPGA implementation of DSP processors.

References:

2. Uwe meyer-Baes, DSP with Field programmable gate arrays, Springer, 2001

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
DSP 10 302B: PATTERN RECOGNITION AND ANALYSIS

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:

- To impart a basic knowledge on pattern recognition and to give a sound idea on the topics of parameter estimation and supervised learning, linear discriminant functions and syntactic approach to Pattern recognition
- To provide a strong foundation to students to understand and design pattern recognition systems.

Module 1: (14 hrs)

Module 2: (12 hrs)
Non-Linear classifiers- Two layer and three layer perceptrons, Back propagation algorithm, Networks with Weight sharing, Polynomial classifiers, Radial Basis function networks, Support Vector machines-nonlinear case, Decision trees, combining classifiers, Feature
selection, Receiver Operating Characteristics (ROC) curve, Class separability measures, Optimal feature generation, The Bayesian information criterion.

**Module 3: (13 hrs)**
Feature Generation 1- Linear transforms-KLT, SVD, ICA, DFT, DCT, DST, Hadamard Transform, Wavelet Transform, Wavelet Packets etc- Two dimensional generalizations - Applications. Feature Generation 2- regional features, features for shape and characterization, Fractals, typical features for speech and audio classification, Template Matching, Context dependent classification-Bayes classification, Markov chain models, HMM, Viterbi Algorithm. System evaluation - Error counting approach, Exploiting the finite size of the data.

**Module 4 (13 hrs)**

**Reference Books**

**Internal continuous assessment: 100 marks**

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

**End semester Examination: 100 marks**

**Question pattern**
Answer any 5 questions by choosing at least one question from each module.

**Module I**
- Question 1: 20 marks
- Question 2: 20 marks

**Module II**
- Question 3: 20 marks
- Question 4: 20 marks

**Module III**
- Question 5: 20 marks
- Question 6: 20 marks

**Module IV**
- Question 7: 20 marks
- Question 8: 20 marks
DSP 10 302C SPREAD SPECTRUM & CDMA SYSTEMS

Teaching scheme
3 hours lecture & 1 hour tutorial per week

Credits: 4

Objectives:
- To study the fundamentals of spread spectrum techniques
- To analyse the performance of various types of spread spectrum

Module I: (14 Hrs)
**Fundamentals of Spread Spectrum:** Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions, spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes - properties and generation of sequences Synchronization and Tracking: delay lock and tau -dither loops, coarse synchronization- principles of serial search and match filter techniques.

Module II: (12 Hrs)
**Performance Analysis of SS system:** Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences Low probability of intercept methods, optimum intercept receiver for direct sequence spread spectrum, Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver

Module III: Networks (14 Hrs)
**Capacity, Coverage and Control of Spread Spectrum Multiple Access:** Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links. Multi-user Detection -MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers.

Module IV: CDMA Systems (12 Hrs)
General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.

Text Books

References

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
Question 2: 20 marks

Module II
Question 3: 20 marks
Question 4: 20 marks

Module III
Question 5: 20 marks
Question 6: 20 marks

Module IV
Question 7: 20 marks
Question 8: 20 marks
Objectives:

- To give an idea of different models used in queuing theory

Module 1: (13 hours)
Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Renewal Theorems.

Module 2: (13 hours)

Module 3: (13 hours)
Single Class & Multi-class Queuing Networks: Simple Markovian queues; M/G/1 queue; G/G/1 queue; Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Service time distributions; BCMP networks; Priority systems.

Module 4: (13 hours)
Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.

References:

Internal continuous assessment: 100 marks

Internal continuous assessment is in the form of periodical tests, assignments, seminars or a combination of all whichever suits best. There will be minimum of two tests per subject. The assessment details are to be announced right at the beginning of the semester by the teacher.

End semester Examination: 100 marks

Question pattern
Answer any 5 questions by choosing at least one question from each module.

Module I
Question 1: 20 marks
The students have to undergo an industrial training of minimum two weeks in a Chemical industry during the semester break after second semester and complete within 15 calendar days from the start of third semester. The students have to submit a report of the training undergone and present the contents of the report before the evaluation committee constituted by the department. An internal evaluation will be conducted for examining the quality and authenticity of contents of the report and award the marks at the end of the semester.

**Internal continuous assessment:** Marks 50
Objective:

- To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

The project work can be a design project / experimental project and or computer simulation project on chemical engineering or any of the topics related with chemical engineering stream. The project work is allotted individually on different topics. The students shall be encouraged to do their project work in the parent institute itself. If found essential, they may be permitted to continue their project outside the parent institute subject to the conditions in clause 10 of M.Tech regulations. Department will constitute an Evaluation Committee to review the project work. The Evaluation committee consists of at least three faculty members of which internal guide and another expert in the specified area of the project shall be two essential members.

The student is required to undertake the masters research project phase-I during the third semester and the same is continued in the 4th semester.(Phase-II). Phase-I consists of preliminary thesis work, two reviews of the work and the submission of preliminary report. First review would highlight the topic, objectives, methodology and expected results. Second review evaluates the progress of the work, preliminary report and scope of the work which is to be completed in the 4th semester.

Internal Continuous assessment:

First Review:

Guide 50 marks
Evaluation Committee 50 marks

Second review:

Guide 100 marks
Evaluation Committee 100 marks

Total 300 marks
FOURTH SEMESTER

DSP 10 401(P): MASTERS RESEARCH PROJECT (PHASE - 2)

Teaching scheme: 30 hours per week  
Credits: 12

Objectives:

To improve the professional competency and research aptitude by touching the areas which otherwise not covered by theory or laboratory classes. The project work aims to develop the work practice in students to apply theoretical and practical tools/techniques to solve real life problems related to industry and current research.

Masters Research project phase-II is a continuation of project phase-I started in the third semester. Before the end of the fourth semester, there will be two reviews, one at middle of the fourth semester and other towards the end. In the first review, progress of the project work done is to be assessed. In the second review, the complete assessment (quality, quantum and authenticity) of the Thesis is to be evaluated. Both the reviews should be conducted by guide and Evaluation committee. This would be a pre qualifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper is to be prepared for possible publication in journal or conferences. The technical paper is to be submitted along with the thesis. The final evaluation of the project will be external evaluation.

Internal Continuous assessment:

First review:

Guide 50 marks
Evaluation committee 50 marks

Second review:

Guide 100 marks
Evaluation committee 100 marks