

**PROPOSED CURRICULA AND SYLLABI  
FOR**

# M.Tech ELECTRONICS

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w.e.f.  
Academic Year 2010-2011 onwards



SGGSIE & T, Nanded

Department of Electronics and Telecommunication Engineering  
Shri Guru Gobind Singhji Institute of Engineering & Technology  
Vishnupuri, Nanded- 431606  
[May 2010]

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# TITLE OF THE PROGRAMME: M.Tech. Electronics

(Intake Capacity: 18)

## CURRICULA AND SYLLABI:

### M.TECH. (ELECTRONICS) - COURSES OF STUDY

*N.B. All Courses have L-P-C as mentioned in the brackets*

| <b>PART-I (20 Credits)<br/>(15-10-20)</b> |   | <b>PART-II (20 Credits)<br/>(15-10-20)</b>  |  |
|---|---|---|--|
| <b>Course Code</b>                        | <b>Course Name</b>                            | <b>Course Code</b>                          | <b>Course Name</b>                       |
| MEC501                                    | Modern Digital System Design<br>(3-0-3)       | MEC601                                      | Modern Wireless Communication<br>(3-0-3) |
| MEC502                                    | Advanced Digital Signal Processing<br>(3-2-4) | MEC602                                      | Adaptive Signal Processing<br>(3-2-4)    |
| MEC503                                    | Digital Image Processing<br>(3-2-4)           | MEC603                                      | Embedded Systems Design<br>(3-2-4)       |
| MEC5xx                                    | Program Elective-I<br>(3-2-4)                 | MEC6xx                                      | Program Elective-III<br>(3-2-4)          |
| MEC5xx                                    | Program Elective-II<br>(3-2-4)                | MEC6xx                                      | Program Elective-IV<br>(3-2-4)           |
| MEC509                                    | Seminar-I<br>(0-2-1)                          | MEC609                                      | Seminar-II<br>(0-2-1)                    |
| <b>Program Electives I and II (3-2-4)</b> |   | <b>Program Electives-III and IV (3-2-4)</b> |  |
| MEC504                                    | Information Theory and Coding                 | MEC604                                      | Soft Computing and Applications          |
| MEC505                                    | Pattern Recognition                           | MEC605                                      | Data Warehousing and Data Mining         |
| MEC506                                    | Artificial Neural Networks and Applications   | MEC606                                      | Multimedia systems and Applications      |
| MEC507                                    | Semiconductor Devices and Technology          | MEC607                                      | Computer Vision                          |
| MEC508                                    | Advanced Computer Architecture                | MEC608                                      | Advanced VLSI Design                     |
|   |   | MEC610                                      | Analog IC Design                         |
| <b>PART-III (24 Credits)</b>              |   | <b>PART-IV (24 Credits)</b>                 |  |
| MEC701                                    | Project Part-I<br>(0-24-24)                   | MEC702                                      | Project Part-II<br>(0-24-24)             |

\*Added New Elective in Second Semester.

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## MEC501 Modern Digital System Design (3-0-3)

**Review of logic design fundamentals:** Combinational logic, logic simplification, Quine McClusky minimization, Hazards in combinational networks.

**Sequential machines:** Concept of memory, design of clocked flip flops, practical clocking aspects concerning flip flops, clock skew, traditional approaches in sequential machine analysis and design, Reduction of state tables and state assignments.

**Asynchronous FSM:** Designing, cycles and races, hazards-static, dynamic and essential Hazards.

**Computer Arithmetic:** Design of fixed point, floating point arithmetic units, MAC and SOP, CORDIC architectures.

**Design using VHDL:** Entities and architectures, Data objects, types, design description, libraries, synthesis basics, mapping statements to Gates, model optimization, verification, test benches, Architectural synthesis, optimization, data path synthesis, logic level synthesis and optimization Cell library binding

**Hardware testing and design for testability (DFT), FPGA:** Fundamental concepts, technologies, origin, alternative FPGA architectures, Configuration, Comparison with ASICs, Reconfigurable computing, Field Programmable node arrays, signal integrity and deep sub micron delay effects.

### REFERENCES:

1. William I Fleatcher, An Engineering approach to digital design, PHI
2. Giovanni De Micheli, Synthesis and optimization of digital circuits (McGraw Hill)
3. Charles H Roth, Jr., Fundamentals of Logic Design, Jaico Book
4. Charles H Roth, Jr., Digital System Design using VHDL, Brooks/Cole Thomson learning
5. Kevin Skahill, VHDL for programmable Logic, Addison Wesley
6. Clive Max Maxfield, The Design Warriors Guide to FPGA Devices, tools and flows, Elsevier
7. J.P. Hayes, Computer Architecture and Organization, Mc Graw Hill.

### Course Objectives:

- It introduces the concept of information theory i.e. entropy, self and mutual information.
- It supports understanding and practicing, designing source encoding and decoding.
- It helps to understand characterization of information channels and its applications.
- It supports understanding and practicing, designing information channel encoding and decoding.
- It helps to understand characterization of coded modulation techniques and its applications

## MEC502 Advanced Digital Signal Processing (3-2-4)

Fundamentals of DSP background and review of discrete time random signals.

Discrete Fourier Transform: representation, properties and computation of the DFT (FFT), decimation in time and frequency.

Filter design techniques: Design of IIR filters, Impulse invariance, bilinear transformation, Design of FIR filters by windowing and frequency sampling

Quantization effects: Effect of round off noise in digital filter, zero input limit cycles in fixed point realization of IIR digital filters. Effects of finite register length in DFT computations.

Multirate digital signal processing: Fundamentals of Multirate systems, Basic multirate operations, Decimation, interpolation, filter design and implementation of sampling rate conversion, polyphase

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filter structures, time variant filter, structures, multistage implementation of sampling rate conversion of BP signals, sampling rate conversion by an arbitrary factor, interconnection of building blocks, polyphase representation, multistage implementations.

Wavelet Transform: Introduction to wavelets, wavelets and wavelet expansion systems, discrete wavelet transform, multiresolution formulation of wavelet systems, Haar Wavelet and other wavelet representations, scaling function, wavelet functions, Parseval's theorem,

#### REFERENCES:

1. S. K. Mitra, Digital signal processing: A computational approach, TMH
2. Johny Johnson, Introduction to digital signal processing, PHI.
3. Oppenheim, Schafer, and Buck, Discrete-time signal processing, Pearson Education LPE
4. P. P. Vaidyanathan, Multirate filters and Filter banks, PH International, Englewood Cliffs
5. Rabiner and Schafer, Multirate signal Processing, PH International, Englewood Cliffs
6. C. S. Burrus, Ramose and A. Gopinath, Introduction to Wavelets and Wavelet Transform, Prentice Hall Inc.

#### Course Objectives:

- Design of FIR, Half band, and IIR filters
- Compute and Interpret Discrete Fourier Transform, Short Time Four Transform
- Analyze multirate DSP systems.
- Determine coefficients for perfect reproduction filter banks and wavelets.
- Understand Wavelet Transform, Choose parameters to take a wavelet transform, interpret and process the result.

### MEC503 Digital Image Processing (3-2-4)

Introduction: Digital image representation, fundamental steps in image processing, elements of digital image processing systems, hardware for image processing system, Frame Grabber, Characteristics of image digitizer, Types of digitizer, Image digitizing components, Electronic image tube cameras, solid state cameras, scanners.

Digital image fundamentals: Elements of visual perception, a simple image model sampling and quantization some basic relationship between pixels, image geometry,

Basic transformations, perspective transformation, camera model and calibration, stereo imaging.

Image transforms: 2-D Fourier transform, Fast Fourier transform, Other separable transforms, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, wavelet Transform, Haar function, Gabor Transform, Hotelling transforms.

Image enhancement: Enhancement by point processing, spatial filtering, enhancement in the frequency domain, Color image processing.

Image restoration: Degradation model, diagonalization of circulate and block-circulate matrices, algebraic approach to restoration, inverse filtering, least mean square (wiener) filter, constrained least squared restoration, invractive restoration.

Image compression: Redundancies, image compression models, elements of information theory, error-free compression variable length coding, bit plane coding, lossless predictive coding, lossy compression, predictive coding, transform coding, video compression, image compression standards- JPEG, MPEG.

Image Analysis: Segmentation, detection of discontinuities, edge linking and boundary detection, thresholding, region -oriented segmentation, Representation and description: Representation schemes, descriptors, regional descriptors, pattern and pattern classes, Classifiers.

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**REFERENCES:**

1. R. C. Gonzalez and R. E. Woods, Digital image processing, Addison-Wesley Publishing House.
2. A. K. Jain, Fundamentals of digital image processing, Prince-Hall India.
3. K. R. Castleman, Digital Image Processing, Prince-Hall International.

**Course Objectives:**

- Understand bases of the human visual system
- Understand bases of digital image formation
- Understand the concepts of quantization, sampling, and special frequency
- Understand the application of Sampling Theorem to 2D cases
- Understand the color image foundations
- Apply intensity transformations to images
- Apply frequency transformations (DFT, IDFT, DCT) to images
- Implement special and frequency-domain image filtering
- Understand and be able to apply image restoration/reconstruction techniques with linear degradation and in presence of additive noise
- Understand and be able to apply image compression
- Understand the concept of multiresolution in 2D cases
- Expose students to current technologies and issues that are specific to image processing systems
  - Develop hands-on experience in using computers to process images
  - Familiarize with MATLAB Image Processing Toolbox

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## Program Electives-I and II (3-2-4)

### MEC504 Information Theory and Coding (3-2-4)

Introduction to Information theory and coding, Probability, random variables, probability distribution and probability densities, functions of random variables, statistical averages of random variables, some useful probability distributions.

Fundamental Limits on Performance: Mathematical models for information sources, a logarithmic measure of information, average mutual information and entropy, information measures for continuous random variables, coding for discrete sources, coding for discrete memoryless sources, Lempel-Ziv algorithm.

Source Coding: Coding for analog sources-optimum quantization, scalar quantization, vector quantization, coding techniques for analog sources, temporal waveform coding, PCM, DPCM, adaptive PCM and DPCM, DM, spectral waveform coding, model based source coding.

Channel models and channel capacity

Error Control Coding: Linear block codes, generator matrix and parity check matrix, some specific linear block codes, cyclic codes, transfer function of a convolution code, optimum decoding of convolution codes-Viterbi algorithm, BCH codes.

Coded Modulation technique: BPSK, QPSK, 8PSK, QAM and Trellis coded modulation techniques.

Advances in Information theory and coding.

#### REFERENCES:

1. Ranjan Bose, Information Theory, Coding and Cryptography, TMH.
2. G. A. Jones and J.M. Jones, Information Theory and Coding, Springer.
3. J. G. Proakis, Digital Communication, Fourth Edition, McGraw Hill
4. Simon Haykin, Digital Communication, John Wiley and Sons.
5. J. G. Proakis and M. Salehi, Communication Systems, 2nd Ed.
6. B. Sklar, Digital communications Fundamentals and applications, Pearson Education

#### Course Objectives:

- It introduces the concept of information theory i.e. entropy, self and mutual information.
- It supports understanding and practicing, designing source encoding and decoding.
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- It helps to understand characterization of coded modulation techniques and its applications

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## MEC505 Pattern Recognition (3-2-4)

Pattern recognition overview: Engineering approach to PR relationship of PR to other areas Pattern recognition applications, pattern techniques, pattern recognition approaches (StatPR, SyntPR, NeurPR).

Features and feature extractions techniques: Introduction, zoned features, Graph representation techniques, sequentially detected features, feature extraction, feature vector and feature space.

Bays decision theory: Introduction, bays decision theory continuous case, two category classification, minimum error rate classification, classifier, discriminate functions and decision surfaces (multicategory and two category case). The normal density function (Univariate and multivariate normal density function)

Parameter estimation and supervised learning: maximum likelihood estimation, Bayes classifier, general Bayesian learning, problem of dimensionality, non-parametric techniques, density estimation, Parzen window, k-nearest estimation, nearest neighbor rule.

Linear discriminate functions: Linear discriminate functions and decision surface, two category and multi-category case generalized linear discriminate functions, minimizing the perception criteria functions, relaxation procedure.

Learning: Unsupervised learning, automatic determination of features, a relational system, transference of learning, associative memory, scientific basis for automatic pattern recognition.

Contextual: Linguistic and array techniques, context, scene, analysis, picture syntax, analysis of synthesis, iterate array techniques.

Coefficient analysis: Higher moments, slit scanning techniques, Fourier transformation, pattern recognition by Fourier optics, autocorrelation, speech recognition.

### REFERENCES:

1. R. O. Duda and P. E. Hart, Pattern classification and scene analysis, Wiley Interscience publications.
2. Robert Schalkoff, Pattern recognition: statistical, structural and neural approaches, John Wiley and Sons. Inc.
3. J.R. Ullmann, Pattern recognition techniques, Butterworths publications, London
4. Don Person (ed.), Image processing, MGH.

### Course Objectives:

- Understand the nature and inherent difficulties of the pattern recognition problems.
- Understand concepts, trade-offs, and appropriateness of the different feature types and classification techniques such as Bayesian, maximum-likelihood, etc.
- Select a suitable classification process, features, and proper classifier to address a desired pattern recognition problem.
- Demonstrate algorithm implementation skills using available resources and be able to properly interpret and communicate the results clearly and concisely using pattern recognition terminology.

## MEC506 Neural Networks and its Applications (3-2-4)

Brain Style Computing: Origins and Issues, Biological neural networks, Neuron Abstraction, Neuron Signal Functions, Mathematical Preliminaries, Artificial Neurons, Neural Networks and Architectures Pattern analysis tasks: Classification, Clustering, mathematical models of neurons, Structures of neural networks, Learning principles.

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Feed forward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Pattern classification and regression using MLFFNNs, Error backpropagation learning, Fast learning methods: Conjugate gradient method.  
Autoassociative neural networks, Pattern storage and retrieval, Hopfield model, recurrent neural networks  
Bayesian neural networks, Radial basis function networks: Regularization theory, RBF networks for function approximation, RBF networks for pattern classification  
Self-organizing maps: Pattern clustering, Topological mapping, Kohonen's self-organizing map  
Introduction to cellular neural network, Fuzzy neural networks, Pulsed neuron models  
Recent trends in Neural Networks

#### REFERENCES:

1. Satish Kumar, Neural Networks, A Classroom Approach, Tata McGraw-Hill, 2003
2. Jacek Zurada, Introduction to Artificial Neural Networks, Jaico Publishing House, 1997.
3. S.Haykin, Neural Networks, A Comprehensive Foundation, Prentice Hall, 1998.
4. C.M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
5. B.Yegnanarayana, Artificial Neural Networks, Prentice Hall of India, 1999.
6. L.O. Chua and T. Roska, Cellular Neural Networks and Visual Computing Foundation and Applications, Cambridge Press, 2002.

#### Course Objectives:

- To introduce the neural networks as means for computational learning
- To present the basic network architectures for classification and regression
- To give design methodologies for artificial neural networks
- To provide knowledge for network tuning and overfitting avoidance
- To demonstrate neural network applications on real-world tasks
- To introduce the fusion of Fuzzy and Neural systems

## MEC507 Semiconductor Devices and Technology (3-2-4)

**Review of Physics of Semiconductor Theory:** Introduction, crystal structure of solids, theory of solids, semiconductor in equilibrium, charge carriers in semiconductors, dopant atoms and energy levels, carrier distributions in extrinsic semiconductors, effects of doping on carrier concentration, effects of doping and temperature on the position of Fermi-Energy level, carrier transport and excess carrier phenomena, carrier drift and diffusion, Carrier generation and recombination, Hall effect.

**Semiconductor Devices:** pn-junction diode, metal-semiconductor contact, two-terminal MOS capacitor, potential differences in MOS capacitor, CV-characteristics of MOS capacitor, fundamentals of Metal Oxide Semiconductor, Field Effect Transistor (MOSFET), MOSFET additional concepts, Long-channel and Short-channel MOSFET.

**Additional topics in semiconductor physics:** Non-equilibrium excess carriers in semiconductors, Carrier generation and recombination, analysis of excess carriers, ambipolar transport, Haynes-Shockley experiment, quasi-Fermi energy levels, excess carrier lifetime, surface effects.

**Other Semiconductor Devices:** Bipolar Junction Transistor, BJT additional concepts, JFET, etc.

**Modeling of Semiconductor Devices:** Low frequency and High-frequency models of pn-junction, MOSFET, and BJT

**Semiconductor Technology:** Electronic Grade Silicon, Crystal Growth, Oxidation techniques and Systems, Oxide Properties, Lithography Techniques, Etching Mechanisms, Diffusion, Models of Diffusion in Solids, Flick's One Dimensional and 2-D diffusion equations, Implantation, Deposition



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Processes, poly-silicon.

**Process Integration and IC Manufacturing:** IC Technology, NMOS IC Technology, CMOS IC Technology, Bipolar IC Technology, MEMS technology, IC Fabrication, VLSI Assembly technology, Package Fabrication Technology, Future trends like SOC, low-power, new materials, etc.

**REFERENCES :**

1. Donald Neamen, Introduction to semiconductor devices, International Edition, McGraw Hill, 2006
2. Ben G. Streetman and Sanjay Banerjee, Solid State Electronic Devices, Prentice Hall, 1999
3. Simon M. Sze, Physics of Semiconductor Devices, John Wiley and Sons, 1999
4. Gary S. May and Simon M. Sze, Fundamentals of Semiconductor Fabrication, Wiley, 2004
5. Bebrad Razavi, Fundamentals of Micro-electronics, Wiley, 2008

**Course Objectives:**

- To develop insight into the semiconductor in equilibrium.
- To study Device fabrication technology.
- To study carrier transport and excess carrier phenomena in semiconductors.
- The pn junction and metal semiconductor contact.
- To study and apply MOS transistors for building circuits.
- Understanding Nonequilibrium excess carriers in semiconductors.
- To study and apply BJT transistors for building circuits.
- Analyze the heterojunction and heterojunction devices.
- Analyse optical devices.

## **MEC508 Advanced Computer Architecture (3-2-4)**

Fundamentals of Computer Design: Introduction to computer design, Changing face of computing and task of computer designer, Technology trends, Cost, price and their trends, Measuring and reporting performance, Quantitative principles of computer design, RISC versus CISC, Major organizational issues of processor design: data path and control design.

Instruction set principles: Introduction, Classifying instruction set architectures, Memory addressing, Addressing modes for signal processing, Type and size of operands and operations, type of operands and operations for media and signal processing, Instructions for control flow, encoding of an instruction set, Role of compilers, MIPS architecture, fallacies and pitfalls.

Instruction level parallelism and its dynamic exploitation:

Instruction level parallelism concepts and challenges, overcoming data hazards with dynamic scheduling, Basic and intermediate concepts of pipelining: Introduction, the major hurdle of pipelining, RISC pipelined data path.

Memory Hierarchy Design: Introduction, Review of ABCs of caches, cache performance, reducing cache miss penalty, reducing cache miss rate, reducing cache hit time, virtual memory: protection and examples of virtual memory.

Parallel processing: Trends towards parallel processing, parallelism in uniprocessor systems, classification of parallel computers and their structures, applications of parallel processing.

Storage Systems: Introduction, types of storage devices, I/O performance measures, RAID: Redundant array of inexpensive disks, errors and failures in real systems.

**REFERENCES:**

1. John L. Hennessy and David A. Patterson, Computer Architecture, A Quantitative Approach (2<sup>nd</sup>. Ed.), Morgan Kaufmann

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2. P. Chaudhuri, Computer Organization and Design (2<sup>nd</sup> Ed.), PHI
  3. J.P.Hays, Computer Architecture and Organization (3<sup>rd</sup> Ed.), Mc Graw Hill
  4. Kai Hwang and Fay'e A. Briggs, Computer Architecture and Parallel Processing, Mc Graw Hill.

**Course Objectives:** To provide students with:

- A broad understanding of RISC and CISC computer architecture and
- To the extent possible, an understanding of the current state-of-the-art in uniprocessor computer architecture.
- Historical perspective on computer system design
- To understand the concepts of pipelining, parallel processing

### **MEC509 Seminar -I (0-2-1):**

The seminar should be done on any topic in Electronics Engineering to be decided by the students and the supervisor concerned. Seminar work shall be in the form of report to be submitted by the student at the end of the semester. The candidate will deliver the talk on the topic for half an hour and assessment will be made by two internal examiners appointed by DPGPC, one of them will be supervisor. Usually MEC110 will be related to the dissertation topic.

Course Objectives:

To Study

- how research papers are written,
- how to read such papers critically and efficiently,
- how to summarize and review them.
- how to gain an understanding of a new field, in the absence of a textbook
- how to judge the value of different contributions
- how to identify promising new directions

## **SEMESTER \_ II**

### **MEC601 Modern Wireless Communication (3-0-3)**

Wireless Transmission: Frequencies for radio transmission, Signals, Signal propagation, Multiplexing, Modulation techniques: modulation schemes such as ASK, FSK, PSK, DPSK, BPSK, QPSK, Advanced frequency shift keying, Advanced phase shift keying, Gaussian minimum shift keying., Spread spectrum such as DSSS, FHSS, and Cellular systems.

Medium access control: Motivation for a specialized MAC, SDMA, FDMA, TDMA, CDMA, and Comparison of S/T/F/CDMA.

Introduction to wireless communication stems: Examples of Wireless communication systems, Paging systems, Cordless telephone systems, and Cellular telephone systems.

Cellular Telephony: Frequency reuse principle, Transmitting, Receiving, Handoff, Roaming, First, Second, and third wireless generation systems.

The Cellular concepts –System design fundamentals: Channel assignment strategies, Interference and system capacity, SIR calculations, Trunking and grade of service, and improving coverage & capacity in cellular systems,

Telecommunication systems: GSM, DECT and Tetra.

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Wireless LAN: Infra red vs. radio transmission, Infrastructure and ad-hoc network, IEEE 802.11-System architecture protocol architecture HIPERLAN, Bluetooth-User scenarios, Architecture, and IEEE 802.15.

Mobile network Layer: Mobile IP, Mobile ad-hoc networks: Routing, Destination sequence distance, Dynamic source routing, alternative metrics and overview ad-hoc routing protocols.

Wireless Application protocol: architecture, WDP, WTLS, WTP, WSP, WAE, WML, WML Scripts, WTA, WAP 2.0 architecture, and I-mode

**REFERENCES:**

1. Rappoport, Wireless Communications (Principles and Practices), Prentice Hall.
2. Jochen Schiller, Mobile Communications, Pearson Education, 2004.
3. William Stallings, Wireless Communication and Networks, Pearson Education, 2003.
4. Fourozan, Data communications and Networking, third edition, Tata McGraw-Hill-2004.
5. Fourozan, TCP/IP Suite.

**Course Objectives:**

1. Follow Fundamentals of Wireless communications and cellular communication
2. Overview and study of Digital cellular technologies including GSM, CDMA etc
3. Overview and study of emerging wireless technologies like IEEE 802.11x, WMAN, Wi Max etc
4. Study script languages such as WML, and WML languages
5. Make practice of solving theoretical and numerical problems, objective type questions etc
6. Attempt will be made to create innovation and creativity among students in the subject by giving opportunities in doing projects, Paper presentation, Assignments, Conducting Tests, MCQ etc.
7. Understand the GSM and CDMA networks by visiting the sites.
8. Simulation experiments based on theory

## **MEC602 Adaptive Signal Processing (3-2-4)**

Introduction to adaptive signal processing and adaptive filters, mathematical preliminaries, Wiener filtering and MMSE estimates. Linear prediction, Levinson-durbin algorithm and lattice Filters: Overview of spectral estimation methods. Adaptive algorithms: LMS algorithms, convergence analysis, adaptive noise canceller, Least squares algorithm: general weighted least squares method, recursive least squares algorithm, fast least square algorithm for AR modeling case. Special topics

**REFERENCES:**

01. Monson H. Hays, Statistical Digital Signal Processing, John Wiley and Sons, Inc.
02. Simon Haykin, Adaptive Filter Theory (4th Edition), Prentice Hall
03. Bernard Widrow and Samuel Stearns, Adaptive Signal Processing, Prentice Hall

**Course Objectives:**

- Apply fundamental mathematical tools, in particular stochastic techniques, in the analysis and design of signal processing systems;
- Recognize estimation problems and design, implement and analyses algorithms for solving them;
- To develop the ideas of optimality and adaptation in signal processing. We discuss the design, analysis, and implementation of digital signal processing systems that can be considered optimal in some sense.

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- Primary topics include random signal models, optimal filtering, Wiener theory, theory of adaptation, performance measures, the LMS algorithm, recursive least-squares adaptation.
  - Use software packages such as MATLAB for the analysis and design of signal processing systems;

## **MEC603 Embedded systems Design (3-2-4)**

Introduction: Embedded systems overview, Design Challenges, Processor Technology, IC Technology, Design Technology, Trade-offs,

Custom Single purpose processors, RT level Custom Single purpose processor design, Optimization, General Purpose processors: pipelining, superscalar and VLIW architectures, Programmers view: Instruction set, program and data memory space, I/O, interrupts, operating system, Development environment: design flow and tools, testing and debugging, Application specific instruction set processors (ASIPs), microcontrollers, digital signal processors, less-general AIP environments, selecting microprocessors, general purpose processor design

ARM Processors, Architecture of ARM7TDMI processor, Programming model, Registers, operating modes, Instruction set, Addressing modes, memory interface

Standard single purpose processors: peripherals: Introduction, timers, counters and watchdog timers, UART, Pulse width modulators, controlling a DC motor using PWM, LCD controllers, Keypad controllers, stepper motor controllers, ADCs, Real time clocks

Memory: memory write ability and storage permanence, common memory types, composing memory, memory hierarchy and cache, advanced RAM.

Interfacing: introduction, Communication basics, Basic protocol concepts, ISA bus protocol: memory access, Arbitration, Priority arbiter, Daisy chain Arbitration, Network oriented Arbitration methods, multilevel bus architectures, Advanced communication principles, Parallel and serial communication, wireless communication, Layering, error detection and correction, serial protocols, parallel protocols, wireless protocols: IrDA, Bluetooth, IEEE802.11

Digital camera example: Introduction to simple digital camera, requirement specification, design

IC Technology: Full custom, Semi Custom, Gate array semi custom IC technology, Standard cell semi custom IC technology, PLDs

Design Technology: Automation, synthesis, verification: H/W and S/W cosimulation, IP Cores, design process models

Real Time operating systems, introduction, process scheduling, examples of RTOS.

Microprocessor and microcontroller based system design, typical design examples, system design and simulation using simulation software such as Proteus VSM.

### **REFERENCES:**

01. Frank Vahid and Tony Givargis, Embedded system design: A unified hardware/software introduction, John Wiley and Sons, 2002
02. Rajkamal, Embedded System, Tata-Mc Graw Hill Publications

### **Course Objectives:**

To introduce the students to the basic concepts of embedded system design. Specifically, teach the students all aspects of the design and development of an embedded system (Including hardware and embedded software). The course utilizes and applies the skills and knowledge students have gained throughout their prior undergraduate curriculum.

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## Elective III and IV (3-2-4)

### MEC604 Soft Computing and Applications (3-2-4)

Soft Computing: Introduction, requirement, different tools and techniques, usefulness and applications.

Fuzzy sets and Fuzzy logic: Introduction, Fuzzy sets versus crisp sets, operations on fuzzy sets, Extension principle, Fuzzy relations and relation equations, Fuzzy numbers, Linguistic variables, Fuzzy logic, Linguistic hedges, Applications, fuzzy controllers, fuzzy pattern recognition, fuzzy image processing, fuzzy database.

Fuzzy inference and decision making: natural language, linguistic hedges, rule based systems, decomposition of compound rules, likelihood and truth quantification, aggregation of fuzzy rules, synthetic evaluation, preferences and consequences, multi-objective decision making.

Granular Computing: introduction, its importance, data granulation, Applications of granular computing, granular neural network and its different forms.

Hybrid Systems: Neural-Network-Based Fuzzy Systems, Fuzzy Logic-Based Neural Networks,

Rough Set: Introduction, Imprecise Categories Approximations and Rough Sets, Reduction of Knowledge, Decision Tables, and Applications, Rough Fuzzy Neural Networks.

Application of soft computing in pattern recognition. New trends in Soft Computing.

#### REFERENCES:

1. Klir & Yuan, Fuzzy Sets and Fuzzy Logic, PHI, 1997.
2. J.-S. R. Jang, C.-T. Sun, E. Mizutani: Neuro- Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence, PHI, 2005.
3. Learning and Soft Computing, V. Kecman, MIT Press, 2001.
4. Rough Sets, Z. Pawlak, Kluwer Academic Publisher, 1991.
5. Intelligent Hybrid Systems, D. Ruan, Kluwer Academic Publisher, 1997.
6. Timothy J Ross: Fuzzy logic with engineering applications, TMH, 2000.

#### Course Objectives:

1. To introduce soft computing approach and compare it with classical approach
2. To study, model and analyze complex problems - those for which more conventional methods have not yielded low cost, analytic and complete solutions.
3. By the end of the course a student is expected to become able to apply Fuzzy and Rough set concepts as computational tools to solve a variety of problems in their area of interest ranging from Optimization problems to Pattern recognition and control tasks.

### MEC605 Data Warehousing and Data Mining (3-2-4)

Data Warehouse : Introduction, A Multi-dimensional data model, Data Warehouse Architecture, Data Warehouse Implementation.

Data Mining: Introduction, Data Mining, on what kind of Data, Data Mining Functionalities, Classification of Data Mining Systems, Major issues in Data Mining.

Data Preprocessing: Data cleaning, Data Integration & Transformation, Data Reduction, Discretization & Concept Hierarchy Generation, Data Mining Primitives.

Mining Association roles in large databases: Association rule mining, mining single-dimensional Boolean Association rules from Transactional Databases, Mining Multi-dimensional Association rules from relational databases & Data Warehouses.

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Classification & Prediction: Introduction, Classification by Decision tree induction, Bayesian Classification.

Other Classification Methods, Classification by Back propagation, Prediction, Classifier accuracy.

Cluster Analysis: Introduction, Types of data in Cluster analysis, A categorization of major clustering methods, partitioning methods, Hierarchical methods, Density-Based Methods: DBSCAN, Grid-based Method: STING; Model-based Clustering Method: Statistical approach, Outlier analysis.

#### **REFERENCES:**

1. Data Mining Concepts & Techniques, Jiawei Han Micheline Kamber, Morgan Kaufmann Publishers.
2. Data Warehouse Toolkit, Ralph Kinball, John Wiley Publishers.
3. Data Mining, Introductory and Advanced Topics, Margaret H.Dunham, Pearson Education.
4. Data Warehousing in the real world, A Practical guide for Building decision support systems, Sam Anahory, Dennis Murray, Pearson Education.

#### **Course Objectives:**

- Understand the concepts of data warehousing,
- Understand the data mining concepts and techniques,
- Be able to efficiently design and manage data storages using data warehousing and data mining techniques,
- Select and apply appropriate data mining techniques for different applications.

### **MEC606 Multimedia Systems and Application (3-2-4)**

Introduction to multimedia: video, audio, still images, graphics, text, etc.

Concepts of image compression: lossless/lossy compression, entropy coding. Predictive coding, DPCM, image transforms (DCT, wavelet, principal component analysis).

Quantization: uniform, Lloyd's, etc. Image compression standards (JPEG, JPEG-2000), vector quantization, concepts of video compression, motion estimation and motion compression.

Video coding and motion estimation, Video coding standards (MPEG-1, MPEG-2, H261/263/26L), object/model based video coding, video object planes, MPEG-4 standards.

Multimedia synchronization and streaming (audio packet, video packet, time stamping, etc.), inter-media synchronization and intra-media continuity, audio coding, content-based multimedia.

Indexing and retrieval, upcoming multimedia standards- MPEG-7, MPEG-21

Multimedia applications: video conferencing, video-on-demand, multimedia networking.

#### **REFERENCES:**

1. Murat Tekalp, Digital Video Processing, PH-PTR
2. Khalid Sayood, Data Compression, PHI

#### **Course Objectives**

- Introduction to principles and current technologies of computer-based multimedia systems.
- Study of current media types (images, video, audio, graphics etc) and how they are used to create multimedia content.
- Issues in effectively representing, processing, and retrieving multimedia data
- Familiarization with the range of tools used in creating computer-based multimedia.



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## MEC607 Computer Vision (3-2-4)

**INTRODUCTION:** Overview of Computer Vision, Low level and High level Computer Vision, Applications of Computer vision

**EARLY IMAGE PREPROCESSING:**

Scale in image processing, canny edge detection, parametric edge models, edge in multi spectral image, other local preprocessing operators, adoptive neighbourhood preprocessing.

**SHAPE REPRESENTATION AND DESCRIPTION:**

Region identification, contour based shape representation and description, region based shape representation and description, shape classes.

**OBJECT RECOGNITION:**

Knowledge representation, statistical pattern recognition, syntactic pattern recognition, recognition as a graph matching, recognition by using neural network and fuzzy logic.

**IMAGE UNDERSTANDING:**

Image understanding, control strategies, active contour models –shapes, point distribution models, pattern recognition methods in image understanding, scene labeling and constraint propagation, semantic image segmentation and understanding.

**3D VISION, GEOMETRY AND RADIOMETRY, USE OF 3D VISION MOTION ANALYSIS:**

Differential motion analysis methods, optical flow analysis based on correspondence of interest points, Kalman filters.

**REFERENCES:**

1. Milan Sonka, V. Hlavac and Roger Boyle, Image Processing, Analysis and Machine Vision, Second edition, Thomson Asia Pvt. Ltd., ISBN -981 -240- 061 -3.
2. Forsyth and Ponce, Computer Vision: A modern vision, PHI.
3. R. Jain, Computer Vision, TMH.

**Course Objectives:**

- Understand the difficulties that the vision problem involves.
- Design a simple vision system.
- Understand the various edge detectors.
- Implement several image filtering algorithms.
- Understand the different ways that the shape of an object can be recovered.
- Appreciate the issues involved in color, texture, and motion.

## MEC608 Advanced VLSI Design (3-2-4)

**Review of MOS Transistor Theory:** nMOS and pMOS Enhancement transistor, Threshold voltage equations, Body effects, MOS device Design equations, Basic DC equations, Latch-up in CMOS circuits and other second order effects, MOS Models, depletion MOS.

**Introduction to CMOS circuits:** CMOS Logic- Complementary CMOS inverter- DC Characteristics, Noise margin, Static load MOS Inverters, Differential Inverter, the transmission gate, Tristate Inverter, Bi-CMOS Inverters, SPICE Model; Combination logic- static and dynamic design strategies, The NAND and NOR Gates, Compound gates, Multiplexers.

**Designing Sequential logic circuits:** Static latches and registers, Dynamic latches and registers, non bistable sequential circuits.

**CMOS subsystem design:** Adder, Multiplier, Shifter, other arithmetic operators; power and speed tradeoffs; Memory cells and Arrays, ROM, RAM- SRAM, DRAM, clocking disciplines; Design, power optimization, case studies in memory design.

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**CMOS Processing Technology:** Basic CMOS technology, n and p well processes, CMOS Process Enhancements, Layout design rules, layouts of various gates, Technology related CAD issues.

**Circuit Performance Parameters:** Resistance and capacitance estimation, Inductance; Switching characteristics- analytical, empirical delay models, gate delays, CMOS Gate transistor sizing, Zpu/Zpd, Power dissipation, Sizing routing conductors, Charge sharing, Yield, reliability, Scaling of MOS Transistor dimensions.

**Layout Design and Tools:** Transistor structures, Wires and Vias , Scalable Design rules , Layouts of various gates; CMOS logic structures, Clocking strategies, I/O structures, Low power design.

**Floor Planning and Architecture Design:** Floor planning methods, off-chip connections, High level synthesis, Architecture for low power, SOCs and Embedded CPUs, Architecture testing.

#### REFERENCES :

01. Jan M Rabaey, Digital integrated circuits: a design perspective. PHI Publications
02. Neil Weste, Kamran Eshrhgian, Principles of CMOS VLSI design: a systems perspective, 2nd ed., Addison Wesley Publishing company, 1993.
03. Wayne Wolf, Modern VLSI design, Pearson Education.
04. Sung-Mo Kang and Y. Leblebici, CMOS digital Integrated Circuits.
05. Ivan Sutherland. Logical effort, Morgan Kaufeman, CA.

#### Course Objectives:

- Develop insight into the working of MOS transistors.
- Apply principles of digital CMOS VLSI from transistor up to the system level.
- Apply the models of VLSI components and study of economics of design and manufacturing costs.
- Design simulated experiments using CAD tool and verify integrity of CMOS circuit and its layout.
- Design digital circuits that are manufacturable in CMOS.
- Apply the CAD VLSI tool suite layout digital circuits for CMOS fabrication and verify circuits with layout parasitic elements.
- Apply course knowledge and CAD VLSI tools in a team based project.

#### MEC609 SEMINAR (0-2-1):

The seminar should be delivered on any topic in Computer Vision / VLSI Engineering as per the specialization selected by a student and the teachers concerned. Seminar work shall be in the form of report to be submitted by the student at the end of the semester. The candidate will deliver the talk on the topic for half an hour and assessment will be made by two internal examiners appointed by DPGPC, one of them will be supervisor. Usually the seminar MEC210 will be related to the dissertation topic.

#### Course Objectives:

- Find the best examples of research papers in the field of interest which have had impact – in whatever terms the student think are important
- Identify the most promising recent research papers, likely to find application in the future
- Learn how best to present contributions in the field of interest, how to present evidence for claims made, and how to evaluate them critically
- Choose a thesis topic which will impact the area of interest
- Become a seasoned, critical, cynical reader of scientific literature



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## **MEC610: ANALOG IC DESIGN (L-3, T-0, P-2, CREDITS-4)**

1. Introduction to Analog Design, MOS FET as analog device, MOS Device Models, Single Stage Amplifiers, Common Source, Source Follower, Common Gate, Cascode, Folded Cascode
2. Differential Amplifiers, Single ended Differential operation, Basic Differential pair, qualitative and quantitative analysis, Common mode response, Differential pair with MOS loads
3. Passive and active current mirrors, Basic current mirrors, Cascode Current Mirrors, Active current mirrors, Large and small signal analysis, Common Mode properties
4. Frequency response of Amplifiers: General Considerations, Miller effect, Association of poles with nodes, Common Source stage, Source Followers, Common gate stage, Cascode stage, differential pair
5. Noise: Representation of noise in circuits, Noise in single stage amplifiers, Common source, common gate, Source followers, cascade stage, noise in differential pairs, noise bandwidth
6. Feedback: General considerations, Feedback topologies, Effect of loading, effect of feedback on noise
7. Operational amplifiers: One stage and two stage op amps, gain boosting, Common mode feedback, Input range limitation, Slew rate, Power supply rejection, Noise in Opamp
8. Stability and Frequency compensation: Multi pole system, Phase margin, Frequency compensation, Compensation of two stage opamps, other compensation techniques
9. Bandgap references: Supply independent biasing, temperature independent references, PTAT current generation, speed and noise issues
10. Phase locked loops: Simple PLL, Charge pump PLLS, Nonideal effects in PLL, delay locked loops, applications

### **Reference Books:**

1. Behzad Razavi, Design of Analog CMOS integrated circuits, Tata McGraw Hill Edition, 2002
2. Philip E Allen, Douglas R. Holberg, CMOS Analog Circuit Design, Oxford, 2002
3. David A Johns, Ken Martin, Analog Integrated Circuit Design, Wiley Students edition, 2002

### **Course Objectives:**

- Demonstrate an understanding of MOS terminal characteristics and capacitive effects.
- Create integrated circuit layouts showing an awareness of the underlying process technology and layout parasitics as well as their impact on circuit performance.
- Show a working knowledge of and an ability to analyze basic gain stages, current mirrors, and active loads. Students should be able to make choices among these building blocks.
- Select the length, width, and bias level of transistors with an awareness of biasing trade-offs associated with the transistor's level of inversion.
- Analyze a circuit to determine input and output referred noise power spectral density. Students should also be able to propose design modifications to reduce noise levels and be able to determine which transistors contribute most to noise levels.
- Analyze a circuit to determine input and output referred offsets. Students should also be able to propose design modifications to reduce offsets and be able to determine which transistors contribute most to offsets.
- Analyze various single-stage and two-stage opamp circuits to determine gain (differential and common-mode), frequency response, output resistance, short-circuit transconductance, input common-mode range, and output signal range. Students should be able to compensate an opamp for closed loop stability, given a certain feedback factor.
- Compute an opamp's required dc gain, slew rate, and unity-gain frequency based on the required closed-loop settling dynamics of a sample-and-hold system.
- Recognize situations that require common-mode feedback and propose a suitable common-mode feedback scheme comprised of a common-mode detector, an amplifier, and a control

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mechanism. Students should also make choices that lead to a stable common-mode feedback loop with loop dynamics similar to the differentialmode loop.

- Apply the Barkhausen criteria to a circuit or system in order to determine if it is likely to oscillate. Students should be able to analyze various ring-oscillators and LC oscillators to compute the required gain for oscillation and the approximate frequency of oscillation.
- Show awareness of global process variation and its effect on circuit performance.
- Analyze basic voltage and current reference circuits.

## **DISSERTATION**

### **Note:**

- Dissertation work duration is of two semesters.
- All M. Tech. students have to work on the selected dissertation topic compulsorily in the department.
- All students must sign the daily attendance register kept in the office.
- A dissertation topic requiring help of industry or the project is industry based, student is allowed to work outside; but the duration should not be more than 4 months including both semesters. However, in some rare cases if more time is really essential, a prior written permission from DPGPC panel must be sought by the student.

### **MEC701 DISSERTATION PART-I (0-24-24)**

Dissertation shall consist of: Research work done by the candidate in the areas related to the chosen specialization, or Comprehensive and critical review of any recent development in the chosen specialization, or Design and/or development of a product related to the programme done by the candidate.

Following shall be the guidelines for evaluation of dissertation part I

Dissertation Part I shall consist of the following components (whichever applicable)  
Extensive literature survey, Data collection from R&D organizations, Industries, etc.  
Study of the viability, applicability and scope of the dissertation  
Detailed Design (H/W and S/W as applicable), Partial implementation  
A candidate should prepare the following documents for examination  
A term paper in the format of any standard journal based on the work

A detailed report of the work done by the candidate related to dissertation

Every candidate should present himself (for about 30 min.) before the panel of examiners (which will evaluate the dissertation I for TW and Oral marks) consisting of

Head of Department, M. Tech. Coordinator or his nominee, all supervisors.

### **MEC702 DISSERTATION PART-II (0-24-24)**

The dissertation shall be assessed internally by a panel of examiners (similar to the one in dissertation part- I) before submission. The candidate shall submit the dissertation in triplicate to the Head of the institution, duly certified that the work has been satisfactorily completed. The Practical examination (viva-voce) shall consist of a defense presented by the candidate or his/her work in the presence of examiners appointed by the University one of whom will be the supervisor and the other an external examiner.

### **Course objective of Dissertation PART-I MEC 701 and PART-II MEC 702**

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- Apply your theoretical and methodological understanding and skills into devising researchable ideas and specific research questions and hypotheses,
  - Conduct a focused review of the relevant literature and create appropriate conceptual framework,
  - Develop a realistic research design with specific research strategies,
  - Think through and articulate a chapter-by-chapter outline of the intended dissertation,
  - Communicate research ideas and their appropriate theoretical and methodological issues effectively and efficiently,
  - Critique other's ideas paying particular attention to both theoretical and methodological rigor and reality, and
  - Gain understanding of the process of dissertation including stress, time, and project management, committee formation, dissertation proposition and defense, and human subjects reviews.