UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

ELECTRONICS and COMMUNICATION ENGINEERING

SCHEME -2013

VI SEMESTER

ELECTRONICS and COMMUNICATION ENGINEERING (T)

Course No	Name of subject	Credits	Weekly load, hours			C A Marks	Exam Duration Hrs	U E Max Marks	Total Marks
			L	T	D/ P				
13.601	Image Processing (AT)	3	2	1	-	50	3	100	150
13.602	VLSI Design (T)	4	3	1	-	50	3	100	150
13.603	Control Systems (T)	4	3	1	-	50	3	100	150
13.604	Digital Communications (T)	4	3	1	-	50	3	100	150
13.605	Antenna & Wave Propagation (T)	3	2	1	-	50	3	100	150
13.606	Elective II	3	2	1	-	50	3	100	150
13.607	Microcontroller Lab (T)	4	-	-	4	50	3	100	150
13.608	Electronic Product Design & Mini Project (AT)	4	1	-	3	50	3	100	150
	Total	**29**	**16**	**6**	**7**	**400**		**800**	**1200**

13. 606 Elective II

13.606.1	Speech Processing (AT)
13.606.2	Adaptive Signal Processing (AT)
13.606.3	DSP Systems & Architecture (AT)
13.606.4	Professional Ethics (AT)
13.606.5	Wavelets & Applications (AT)
13.606.6	High Speed Semiconductor Devices (T)
13.606.7	Mixed Signal Circuits Design (T)

13.601 IMAGE PROCESSING (AT)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

The students undergoing this course will be able to know.

- *Fundamentals of image processing.*
- *Various transforms used in image processing.*
- *Image processing techniques like image enhancement, reconstruction, compression and segmentation.*

Module – I

Introduction: Fundamental Steps in Image Processing - Components of a Digital Image Processing System - Structure of the human eye - Image sensing and acquisition – Gray scale and Colour Images - Image representation and modelling - Sampling and quantization

Two dimensional systems - 2-D convolution, 2-D correlation

Image transforms: 2-D Discrete Fourier transform – properties, Discrete Cosine, Walsh, Hadamard and Haar transforms.

Module – II

Image Enhancement: Point Operations - Spatial Filters, Filter Masks, Smoothing Filters, Sharpening Filters, High Boost Filters - Frequency domain Filters, Smoothing Filters, Sharpening Filters, Homomorphic filters – Histogram Processing

Image Restoration: Restoration/Degradation model – Estimation of Degradation Function, Restoration using Spatial Filters, Mean Filter, Order Statistic Filter, Adaptive Filter, Inverse Filter, Wiener Filter.

Module – III

Image Segmentation: Point and Line Detection - Edge detections, Gradient operators, Canny Edge Detector - Polygonal Fit Algorithm – Region Growing – Region Splitting and Merging - Thresholding.

Image Representation: Boundary Following, Chain codes, Maximum Perimeter Polygon algorithm, Signatures, boundary segments, skeletons - Boundary descriptors – Regional descriptors – Relational descriptors – Co-occurrence matrix.

Module – IV

Morphological Processing- erosion and dilation, opening and closing, Hit/Miss transformation, Boundary Extraction, Hole Filling, Convex Hull, Thinning, Thickening and Pruning.

Image Compression: Image Compressions models – Huffmann Coding - Arithmetic Coding – Image Compression Standards.

Colour Image Processing: Colour Models, RGB, CMY, HSI – Colour Transformation – Smoothing and Sharpening, Segmentation based on colour.

References:

1. Rafael C Gonzalez and Richard E. Woods, *Digital Image Processing*, 3/e, Addison Wesley.
2. Anil K Jain, *Fundamentals of Digital Image Processing*, PHI, New Delhi, 1995.
3. Jayaraman S., S. Esakkirajan, T Veerakumar, *Digital Image Processing*, TMH, 2009.
4. Kenneth R Castleman, *Digital Image Processing*, PHI, 1995.
5. William K Pratt, *Digital Image Processing*, Wiley India 2/e.
6. Sid Ahmed M A, *Image Processing Theory, Algorithm and Architectures*, McGraw-Hill, 1995.
7. Rafael C Gonzalez and Richard E. Woods, *Digital Image Processing Using MATLAB*, Addition - Wesley, 2004.
8. Haralick R.M. and L.G. Shapiro, Computer and Robot Vision, Vol-1, Addison - Wesley, 1992.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)
30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours   Maximum Total Marks: 100

The question paper shall consist of 2 parts.

Part A (20 marks) - Five Short answer questions of 4 marks each. All questions are compulsory. There should be at least one question from each module and not more than two questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of this course, the students will be able to know the fundamental concepts of image processing.

13.602 VLSI DESIGN (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *Explain device physics of MOS transistor, challenges in device scaling to submicron regime and short channel effects.*
- *Identify state of the art in unit processes to fabricate CMOS chip and develop an idea on the environmental impacts of these processes.*
- *Explain the characteristics of CMOS inverters and design static and dynamic logic using CMOS.*
- *Design data path elements like adders and multipliers in different algorithms, memory elements like RAM, ROM, PLAs.*
- *Draw Stick diagram and layout of inverters and gates.*
- *Distinguish between different test generation methods and explain reliability aspects of VLSI circuits.*
- *Simulate simple MOS circuits using CAD tools.*

Module – I

Material Preparation- Purification, Crystal growth (CZ and FZ process), Slicing and Wafer processing**,** Thermal Oxidation**:** Growth mechanisms, Dry and Wet oxidation, Deal Grove model.

Diffusion**-** Fick's Laws, Pre deposition and drive in processes, diffusion system. Ion implantation**-**Range Theory, channelling, annealing. Epitaxy**-**VPE and MBE, CVD and MBE systems. Lithography**-** Photo lithographic sequence, Electron Beam Lithography, X-ray Lithography, CMOS IC Fabrication Sequence**-** n well, p well, and twin tub process.

Module – II

VLSI Design Flow**-** Design specifications, Behavioral level, RTL, logic Design and Physical Level Design (Basic concepts only)**.** Review of MOS transistor theory- Saturation and Linear regions of Operation of NMOS and PMOS. Review of Short channel and secondary effects of MOSFET.

MOSFET Capacitances**-** Oxide related capacitances, Junction Capacitances. MOSFET Scaling - Constant field, Constant voltage and generalized scaling. Stick diagram and Lay out **-** Design rules (λ and μ rules).

Module – III

CMOS inverter - DC characteristics, Noise margin, Static load inverters, pseudo NMOS, Saturated load inverters. Propagation delay, Static and Dynamic Power dissipation. CMOS logic design - Static logic and Dynamic logic, Domino logic, np- CMOS, Pass transistor logic, Transmission gates, CMOS system design- Adders, Static adder, Dynamic adder, Carry bypass adder, Linear Carry select adder, Square root carry select adder, Carry look ahead adder, Array multipliers.

Module – IV

Memory elements- Timing matrix of Sequential circuits, Static and Dynamic Memory Latches and Registers, Multiplexer based latches, SRAM, DRAM, ROM. Sense amplifiers – Differential, Single ended. Reliability and testing of VLSI circuits – General concept, CMOS testing, Test generation methods. Introduction to VLSI design tools. Introduction to PLDs and FPGAs, Design of PLAs.

References:

1. Tyagi M.S., *Introduction to Semiconductor Materials*, Wiley India
2. Jan M Rabaey, *Digital Integrated Circuits* PHI 2008
3. John P Uyemura, *Introduction to VLSI Circuits and Systems,* Wiley India, 2008
4. Neil H E Weste and Kamram Eshrahian, *Principles of CMOS VLSI Design*, 2/e, Pearson Education.
5. Yuan Taur, Tak Hning, *Fundamentals of Modern VLSI Devices*, Cambridge Uni. Press, 2000.
6. Gandhi S K, *VLSI Fabrication Principles*, 2/e, Prentice Hall.
7. Wayne Wolf, *Modern VLSI Design Systems on Chip,* 3/e, Pearson Education.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 40% Analysis/Numerical Problems.*

Course Outcome:

On completing the course, the student shall be able to:

- *Explain device physics of MOS transistor, challenges in device scaling to submicron regime and short channel effects.*
- *Identify state of the art in unit processes to fabricate CMOS chip and develop an idea on the environmental impacts of these processes.*
- *Explain the characteristics of CMOS inverters and design static and dynamic logic using CMOS.*
- *Design data path elements like adders and multipliers in different algorithms, memory elements like RAM, ROM, PLAs.*
- *Distinguish between different test generation methods and explain reliability aspects of VLSI circuits.*
- *Simulate simple MOS circuits using CAD tools.*

13.603 CONTROL SYSTEMS (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objectives:

- *To understand the methods of representation of systems and deriving their transfer function model.*
- *To give basic knowledge is obtaining the open loop and closed loop frequency responses of systems.*
- *To introduce applications of control systems.*

Module – I

Components of control system – Open loop and closed loop control systems – Mathematical modeling of control systems - Mechanical and electromechanical systems. Design process – Block diagram representation and reduction methods, Signal flow graph and Mason's rule formula. Standard test signals.

Module – II

Time response specifications. Time response of first and second order systems to unit step input, time domain specifications - Steady state error and static error coefficients. Dynamic error coefficient and its evaluation. Stability of linear control systems: methods of determining stability, Routh's Hurwitz Criterion.

Module – III

Frequency domain analysis: Frequency domain specifications, effects of adding a zero and a pole to the transfer function. Nyquist stability criterion: fundamentals and analysis. Relative stability: gain margin and phase margin. Stability analysis with Bode plot. Root Locus Technique: Introduction, properties and its construction.

Module – IV

Design of Control Systems: Introduction, design with PD and PI controllers, Design with phase-lead and phase-lag controllers (frequency domain approach). Transfer function of the zero-order hold and closed loop discrete data systems. State variable analysis: state transition matrix and equation, controllability and observability of linear systems, stability test of discrete data systems using bilinear transformation method and direct stability tests.

References:

1. Benjamin C. Kuo, *Automatic Control Systems*, 8/e, Wiley India.

2. Ogata K., *Discrete-time Control Systems*, 2/e, Pearson Education.
3. Norman S Nise ,*Control System Engineering,*5/e, Wiley India
4. Ogata K., *Modern Control Engineering*, Prentice Hall of India, 4/e, Pearson Education, 2002.
5. Richard C Dorf and Robert H Bishop, *Modern Control Systems,* 9/e, Pearson Education, 2001.
6. Dean Frederick & Joe Chow, *Feedback Control Problems using MATLAB,* Addison Wesley, 2000.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 60 % problems, derivations and proof.*

Course Outcome:

After the studying the course the students will be able to

- *know the methods of representation of systems and deriving their transfer function model.*
- *acquire basic knowledge is obtaining the open loop and closed loop frequency responses of systems.*
- *understand applications of control systems.*

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13.604 DIGITAL COMMUNICATION (T)

Teaching Scheme: 3(L) - 1(T) - 0(P) **Credits**: 4

Course Objective:

- *To understand the concept of Digital representation of analog source*
- *To introduce to various aspects of distortion less data transmission*
- *To have idea on geometrical representation of signals.*
- *To compare Error performance of various band pass modulation techniques.*

Module – I

Pulse Modulation, Sampling process, Aliasing, Reconstruction, PAM, Quantization, PCM, Noise in PCM system, Prediction-Error Filtering for redundancy reduction, Delta modulation, Delta-Sigma modulation, DPCM, ADPCM, ADM, Processing Gain. Performance comparison of various pulse modulation schemes, Line codes.

Module – II

Base band Pulse Transmission Matched filter, properties, Error rate due to noise, ISI

Nyquist criterion for distortion less transmission, Ideal solution, Raised cosine spectrum, Correlative level coding Duobinary coding, precoding, Modified duobinary coding, Generalized Partial response signaling, Base band M-ary PAM transmission, eye pattern, optimum linear receiver. Adaptive Equalization, LMS algorithm, Equalizers.

Module – III

Signalling Over AWGN Channel: Signal space Analysis, Geometric representation of signals, Gram Schmidt orthogonization procedure. Conversion of the continuous AWGN channel into a vector channel, Optimum receivers using Coherent Detection, probability of error. Error probability for BPSK, QPSK and FSK, M-ary Quadrature Amplitude Modulation (QAM),Detection of signals with unknown phase, Non coherent orthogonal modulation, Differential phase shift keying, Comparison of digital modulation schemes.

Module – IV

Spread spectrum communication Pseudo noise sequences, Properties of PN sequences. Generation of PN Sequences, Spread spectrum Communication, Anti jam Characteristics, Frequency Hop spread spectrum with MFSK, Slow and Fast frequency hoping.

Multiple Access Techniques, multipath channels, classification, Coherence time, Coherence bandwidth, Statistical characterization of multi path channels, Binary signaling over a Rayleigh fading channel, Diversity techniques Diversity in time, frequency and space. TDMA and CDMA RAKE receive.

References:

1. Symon Haykins, Digital *Communication Systems*, Wiley India, 2013.
2. Symon Haykins, *Communication Systems*, 4/e Wiley India, 2012.
3. Won Y Yang *et al*., *Matlab/Simulink for Digital Communication*, 2/e SP Surya Page Turners, 2012.
4. Sklar, Ray, *Digital Communication, Fundamental and Applications,* 2/e Pearson, 2011
5. Glover & Grant, Digital Communication, Prentice Hall, 2000.
6. Das Mullick Chatterjee, *Principles of Digital Communication*, Wiley Eastern Ltd.
7. Ramakrishna Rao, *Digital communication*, Tata McGraw Hill Education Pvt. Limited.
8. Hari Bhat, Ganesh Rao, *Digital Communication*, 3/e, Pearson, 2010.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 60% Numerical Problems/ derivations/proofs.*

Course Outcome:

After the course the student will be able to

- *Understand the concept of sampling and quantization*
- *Understand the concept of matched filtering and correlative coding*
- *Understand the idea of geometrical representation of signals.*
- *Understand the Error performance of various band pass modulation techniques*
- *Understand the concept of Spread Spectrum communication*

13.605 ANTENNA & WAVE PROPAGATION (T)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To study various antennas, arrays and radiation patterns of antennas.*
- *To learn the basic working of antennas.*
- *To understand various techniques involved in various antenna parameter measurements.*
- *To understand the propagation of radio waves in the atmosphere.*

Module – I

Basic antenna parameters - gain, directivity, beam solid angle, beam width and effective aperture calculations. Effective height - wave polarization - antenna temperature - radiation resistance - radiation efficiency - antenna field zones - principles of reciprocity. Duality of antennas. Concept of retarded potential. Field, directivity and radiation resistance of a short dipole and half wave dipole.

Module – II

Measurement of radiation pattern, gain, directivity and impedance of antenna
Arrays of point sources - field of two isotropic point sources - principle of pattern multiplication - linear arrays of ‗n' isotropic point sources. Grating lobes. Properties and Design of Broadside, Endfire, Binomial arrays. Basic principle of beam steering.

Module – III

Basic principle of beam steering. Traveling wave antennas. Principle and applications of V and rhombic antennas. Principles of Horn, Parabolic dish and rectangular Patch antennas (expression for E, H, and Gain – no derivation). Principle of Log periodic antenna array and Helical antenna. Antennas for mobile base station and handsets., basic principle of smart antenna.

Module – IV

Radio wave propagation , Modes , structure of atmosphere , characteristics of ionized regions , sky wave propagation , effect of earth's magnetic field , MUF , skip distance ,virtual height , skip distance Ionospheric abnormalities and absorption , space wave propagation , LOS distance , Effective earth's radius , Field strength of space wave , duct propagation , VHF and UHF Mobile radio propagation, tropospheric scatter propagation ,fading and diversity techniques.

References:

1. John D. Krauss, *Antennas for all Applications*, 3/e, TMH.
2. Balanis, *Antenna Theory and Design,* 3/e, Wiley Publications.

3. Jordan E.C. & K G Balmain, *Electromagnetic Waves & Radiating Systems*, 2/e, PHI.
4. Collin R.E, *Antennas & Radio Wave Propagation,* McGraw Hill. 1985.
5. Terman, *Electronics & Radio Engineering*, 4/e, McGraw Hill.
6. Thomas A. Milligan, *Modern Antenna Design*, IEEE PRESS, 2/e, Wiley Interscience.
7. Raju G.S.N., *Antenna and Wave Propagation*, Pearson, 2013.
8. Ganesh Rao and Somanathan Nair, *Antennas and Radio Wave Propagation*, Sanguine 2007.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 50%* problems, derivations and proof.

Course Outcome:

After completion of the course the student will be able to know:

- *various antennas, arrays and radiation patterns of antennas.*
- *the basic working of antennas.*
- *various techniques involved in various antenna parameter measurements.*
- *the propagation of radio waves in the atmosphere.*

13.606.1 SPEECH PROCESSING (AT) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits**: 3

Course Objective:

To study the Speech recognition, Identification, spectrum estimation

Module – I

Nature of Speech Signal**:** Speech production mechanism, Classification of speech sounds, Nature of speech signal.

Speech Signal Processing **:** Review of DSP, Digital models for speech signals, significance of short time analysis.

Module – II

Time Domain Methods**:** Time-domain parameters of speech, methods for extracting the parameters, zero crossings, autocorrelation function, pitch estimation.

Digital representation of Speech Waveform**:** Sampling speech signals, Review of statistical model for speech, Instantaneous quantization, Adaptive quantization, DPCM with adaptive quantization and with adaptive prediction, PCM to ADPCM conversion.

Module – III

Frequency Domain Methods**:** Short time Fourier analysis, Filter back analysis, Spectro graphic analysis, Formant extraction, Pitch extraction, Analysis – synthesis system.

Module – IV

Linear Predictive coding of Speech**:** Formulation of Linear Prediction problem in time domain, solution of normal equations, interpretation of linear prediction in auto correlation and spectral domains.

Homomorphic Speech Analysis **:**Cepstral analysis of speech, formant and pitch estimation. Speech recognition, Speech synthesis and speaker verification.

References:-

1. Rabiner L. R. and R. W. Schafer, *Digital Processing of Speech Signals*, Prentice Hall, 1978.
2. Flanagan J. L., *Speech Analysis Synthesis and Perception,* (2/e), Berlin,1983.
3. Witten I. H., *Principles of Computer Speech,* Academic Press, 1982.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the completion of the course the student will be able to know the Speech recognition, Identification, spectrum estimation

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13.606.2 ADAPTIVE SIGNAL PROCESSING (AT) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Understand the concepts of gradient and mean square error performance in adaptive systems*
- *Explain gradient descent algorithms and gradient estimate*
- *Derive LMS algorithms and formulate conditions of convergence*
- *Explain applications of adaptive signal processing*

Module – I

Adaptive systems: definitions and characteristics, Open and Closed loop adaptation, Adaptive linear combiner, Performance function, Gradient and minimum mean square error, performance function, Gradient and minimum mean square error, Alternate expressions of gradient.

Theory of adaptation with stationary signals: Input correlation matrix, Eigen values and Eigen vectors of the i/p correlation matrix.

Module – II

Searching the performance surface: Basic ideas of gradient search, Stability and rate of convergence, Learning curve, Newton's method, Steepest descent method, Comparison. Gradient estimation and its effects on adaptation: Gradient component estimation by derivative measurement, performance penalty, Variances of the gradient estimate, effects on the weight – vector solution, Excess mean square error and time constants, misadjustments, total misadjustments and other practical considerations.

Module – III

Important adaptive algorithms: LMS Algorithm, Derivation, Convergence of the weight vector, learning curve, noise vector in weight vector solution, misadjustment, performance, Z Transforms in Adaptive signal processing, other adaptive algorithms- LMS Newton , Sequential regression, Recursive least squares, adaptive recursive filters, random search algorithms.

Module – IV

Adaptive Lattice predictor, Adaptive filters with orthogonal signals. Applications of Adaptive signal processing: Adaptive modelling of a multi-path communication channel, adaptive model in geophysical exploration, Inverse modelling, Adaptive interference cancelling: applications in Bio-signal processing.

References:

1. Widrow and Stearns, *Adaptive Signal Processing*, Pearson.
2. Ingle and Kogon Manalokis, *Statistical and Adaptive Signal Processing,* Artech House INC., 2005.
3. Simon Haykin, *Adaptive Filter Theory*, 4th edition, Prentice Hall.
4. Sayed A. H., *Adaptive Filters*-, John Wiley
5. Poularikas A, Z M Ramadan, *Adaptive Filtering Primer with MATLAB*, Taylor and Francis Publications.
6. Tamal Bose, *Digital Signal and Image Processing*, John Wiley Publications.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the course the student will be able to

- *Understand the concepts of gradient and mean square error performance in adaptive systems*
- *Apply gradient descent algorithms, gradient estimate and LMS algorithms in adaptive systems and formulate conditions of convergence*
- *Implement applications of adaptive signal processing.*

13.606.3 DSP SYSTEM AND ARCHITECTURE (AT) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To impart the knowledge of basic DSP filters and number systems to be used and of different types of A/D, D/A conversion errors.*
- *To gain concepts of digital signal processing techniques, implementation of DSP & FFT algorithms and also to learn about interfacing of serial & parallel communication devices to the processor.*

Module – I

Signal-processing system, The sampling process, Discrete time sequences. Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT), Linear time-invariant systems, Digital filters, Decimation and interpolation. Number formats for signals and coefficients in DSP systems, Dynamic Range and Precision, Sources of error in DSP implementations, A/D Conversion errors, DSP Computational errors, D/A Conversion Errors.

Module – II

Basic Architectural features, DSP Computational Building Blocks, Bus Architecture and Memory, Data Addressing Capabilities, Address Generation Unit, Programmability and Program Execution, Speed Issues, Hardware looping, Interrupts, Stacks, Relative Branch support, Pipelining and Performance, Pipeline Depth, Interlocking, Branching effects, Interrupt effects, Pipeline Programming models.

Module – III

Commercial Digital signal-processing Devices, Data Addressing modes of TMS320C54XX DSPs, Data Addressing modes of TMS320C54XX Processors, Memory space of TMS320C54XX Processors, Program Control, TMS320C54XX instructions and Programming, On-Chip Peripherals, Interrupts of TMS320C54XX processors, Pipeline Operation of TMS320C54XX Processors.

Module – IV

Memory space organization, External bus interfacing signals, Memory interface, Parallel I/O interface, Programmed I/O, Interrupts and I/O, Direct memory access (DMA). A Multichannel buffered serial port (McBSP), McBSP Programming, a CODEC interface circuit, CODEC programming, A CODEC-DSP interface example.

References:

1. Avtar Singh and S. Srinivasan, *Digital Signal Processing,* Thomson Publications, 2004.

2. Lapsley et al., *DSP Processor Fundamentals, Architectures& Features*, S. Chand & Co, 2000.
3. Venkata Ramani B. and M. Bhaskar, *Digital Signal Processors, Architecture, Programming and Applications,* TMH, 2004.
4. Jonatham Stein, *Digital Signal Processing*, John Wiley, 2000.
5. Keshab K. Parhi, *VLSI Digital Signal Processing Systems: Design and Implementation,* John Wiley & Sons, 1999.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After successful completion of the course, students will be

- *familiar with the concepts of digital signal processing techniques, basic building blocks and implementation of DSP & FFT algorithms.*
- *able to programme the DSP TMS320C54XX PROCESSOR and decimation interpolation filters/adaptive filters*
- *apply interfacing of serial & parallel communication devices to the processor.*

13.606.4 PROFESSIONAL ETHICS (AT) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *To create awareness on professional ethics for engineers.*
- *To instil human values and integrity.*
- *To respect the rights of others and develop a global perspective.*

Module – I

Understanding Professional Ethics and Human Values Current scenario, contradictions, dilemmas, need for value education and self esteem, Human values, morals, values, integrity, civic virtues, work ethics, respect for others, living peacefully , caring, honesty, courage, valuing time, co operation, commitment, empathy, self confidence, character.

Module – II

Ethics for Engineers, its importance, code of ethics, person and virtue , habits and morals, 4 main virtues, ethical theories, Kohlberg's theory, Gilligan's theory, towards a comprehensive approach to moral behaviour, truth, approach to knowledge in technology, environmental ethics and sustainability, problems of environmental ethics in engineering.

Module – III

Engineering as people serving profession , engineer's responsibility to environment, principles of sustainability, industrial, economic, environmental, agricultural and urban sustainability, Sustainable development. Responsibility for safety and risk, types of risk, designing for safety, risk benefit analysis.

Module – IV

Professional rights and responsibilities, sense of loyalty, confidentiality , knowledge gained confidentiality, collective bargaining, conflict of interest, occupational crime, acceptance of bribes/gifts, Global Issues, computer ethics, weapons development, engineers as expert witness and advisors, ethics and research, Intellectual Property Rights, ethical audit and procedure.

References:

1. Mike W Martin, Roland Schinzinger, *Ethics in Engineering*, Tata McGraw -Hill, 2013.
2. Govindarajan, Natarajan, Senthil Kumar, *Engineering Ethics*, PHI , 2009.
3. Aarne Vesblind P, Alastair S Gunn, *Engineering Ethics and the Environment*, Cambridge Universities Press.1998.

4. Edmund Seebauer, Robert Barry, *Fundamentals of Ethics for Scientists and Engineers*, Oxford University Press, 2001.
5. Gaur R. R., R. Sangal, G. P. Bagaria, *A Foundation Course in Value Education and Professional Ethics*, Excel Books, New Delhi, 2009.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Course Outcome:

After the completion of this course, student will be familiar with the human values and ethics in engineering.

13.606.5 WAVELETS & APPLICATIONS (AT) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

- *Understand Short Time Fourier Transform*
- *Explain theory of frames*
- *Derive basic postulates in CWT and DWT and explain multi resolution analysis*
- *Understand orthonormality and fast wavelet transform algorithms*
- *Explain applications of wavelet transforms*

Module – I

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

Wavelets - The basic functions, Specifications, Admissibility conditions, Continuous wavelet transform (CWT), Discrete wavelet transform (DWT).

The multiresolution analysis (MRA) of L2(R) - The MRA axioms, Construction of an MRA from scaling functions.

Module – III

The dilation equation and the wavelet equation, Compactly supported orthonormal wavelet bases - Necessary and sufficient conditions for orthonormality.

Wavelet transform - Wavelet decomposition and reconstruction of functions in L2(R). Fast wavelet transform algorithms - Relation to filter banks, Wavelet packets.

Module – IV

Wavelet Transform Applications: Image processing - Compression, Denoising, Edge detection and Object detection. Audio - Perceptual coding of digital audio. Wavelet applications in Channel coding.

References:

1. Vaidyanathan P. P, *Multirate Systems & Filter Banks* , PTR, PH, 1993
2. Gilbert Strang, *Linear Algebra and its Applications*.

3. Reghuveer M. Rao, Ajit S. Bopardikar, *Wavelet Transforms – Introduction to Theory and Applications*, Pearson Education Asia, 1998

4. Strang G. S., T. Q. Nguyen, *Wavelets and Filter Banks*, Wellesley, Cambridge Press, 1996.

5. Burrus C. S., R. A. Gopinath and H. Gao, *Introduction to Wavelets and Wavelet Transforms: A Primer*, Prentice Hall, 1998.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, problems based on MATLAB / any other software packages covering the syllabus etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer two full question out of the three from each module. Each question carries 10 marks.

Note: *Question paper should contain minimum 60% Numerical Problems/ derivations/proofs.*

Course Outcome:

At the end of the course, the student shall be able to

- *Understand Short Time Fourier Transform*
- *Explain theory of frames*
- *Derive basic postulates in CWT and DWT and explain multi resolution analysis*
- *Understand orthonormality and fast wavelet transform algorithms*
- *Explain applications of wavelet transforms*

13.606.6 HIGH SPEED SEMICONDUCTOR DEVICES (T) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

To study the

- *the properties of materials used for high frequency devices*
- *high frequency device fabrication process*
- *principle of operation of high frequency devices and characteristics*

Module – I

Important parameters governing the high speed performance of devices and circuits: Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature.

important parameters governing the high power performance of devices and circuits: Break down voltage, resistances, device geometries, doping concentration and temperature.

Module – II

Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs, SiC, GaN etc.), different SiC structures, silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices, outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials, electric field characteristics of materials and device processing techniques, Band diagrams, homo and hetro junctions, electrostatic calculations, Band gap engineering, doping, Material and device process technique with these III-V and IV – IV semiconductors.

Module – III

Metal semiconductor contacts and Metal Insulator Semiconductor and MOS devices: Native oxides of Compound semiconductors for MOS devices and the interface state density related issues. Metal semiconductor contacts, Schottky barrier diode, Metal semiconductor.

Field Effect Transistors (MESFETs): Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics, Velocity overshoot effects and the related advantages of GaAs. InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.

Module – IV

High Electron Mobility Transistors (HEMT): Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT, InGaAs/InP HEMT structures: Hetero junction Bipolar transistors (HBTs): Principle of operation and the benefits of hetero junction BJT for high speed applications.

GaAs and InP based HBT device structure, SiGe HBTs and the concept of strained layer devices; High Frequency resonant – tunneling devices, Resonant-tunneling hot electron transistors.

References:

1. Chang C.Y., F. Kai, *GaAs High-Speed Devices: Physics, Technology and Circuit Applications*, Wiley.
2. Cheng T. Wang, Ed., *Introduction to Semiconductor Technology: GaAs and Related Compounds*, John Wiley.
3. David K. Ferry, Ed. Howard W., *Gallium Arsenide Technology*, Sams & Co., 1985.
4. Avishay Katz, *Indium Phosphide and Related Materials: Processing, Technology and Devices*, Artech House, 1992.
5. Sze S.M., *High Speed Semiconductor Devices*, Wiley 1990
6. Ralph E. Williams, *Modern GaAs Processing Methods*, Artech ,1990,
7. Sandip Tiwari, *Compound Semiconductor Device Physics*, Academic Press, 1991.
8. Armstrong G.A., C.K. Maiti, *TCAD for Si, SiGe and GaAs Integrated Circuits*, The Institution of Engineering and Technology, London, United Kingdom, 2007.
9. Ruediger Quay, *Gallium Nitride Electronics*, Springer 2008, (Available on NITC intranet in Springer eBook section)
10. Alessandro Birolini, *Reliability Engineering Theory and Practice*, Springer, 2007.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 60% Numerical Problems/ derivations/proofs.*

Course Outcome:

At the end of the course, the student shall be able to

- *Explain the properties of materials used for high frequency devices*
- *Explain High frequency device fabrication process*
- *Explain principle of operation of high frequency devices and characteristics*

13.606.7 MIXED SIGNAL CIRCUIT DESIGN (T) (Elective II)

Teaching Scheme: 2(L) - 1(T) - 0(P) **Credits:** 3

Course Objectives:

The course shall provide

- *Understanding on analog and digital models of short channel*
- *Switching characteristics of static circuits, pass transistor and transmission gate logic.*
- *Design of Two stage OP AMPS, Compensation circuits, Open Loop Comparators.*
- *Design of dynamic circuits, Design Concept of ADCs and DACs*
- *Use of Mixed signal simulation tools*

Module – I

Analog and digital MOSFET models of MOS, CMOS inverter – DC characteristics – switching characteristics, Static logic gates- NAND and NOR gates- DC and Switching characteristics-pass transistor and transmission gate logic.

Module – II

Single Stage Amplifiers: Common Source with resistive load, diode connected loads and current source load, source follower, Common gate and Cascode stage.

Differential Amplifiers- Differential and common mode gains, and CMRR with resistive load, Differential pair with MOS load, Current Mirror Load Differential Amplifiers, Design of current mirror load differential amplifiers.

Module – III

CMOS OP AMPS- Characterization of OP AMP, Two Stage Operational Amplifiers -Frequency compensation of OPAMPS - miller compensation, controlling right half plane zero, Design of classical Two Stage OP AMP, Design of Two Stage open Loop Comparator, Principle of Analog Multiplier.

Module – IV

Dynamic analog circuits – charge injection and capacitive feed through in MOS switch – sample and hold circuits, Switched Capacitor Circuits- Switched Capacitor Integrator, Sense amplifiers-Single Ended and Dual Ended.

Data Converters DAC and ADC Specifications-DNL, INL, latency, SNR, Dynamic Range. DAC Architecture – Resistor String, Current steering, Charge Scaling and Pipeline types. ADC Architecture- Flash and Pipe line types.

References:

1. Baker, Li, Boyce, *CMOS: Circuits Design, Layout and Simulation*, Prentice Hall India, 2000.
2. Phillip E. Allen, Douglas R. Holbery, *CMOS Analog Circuit Design*, Oxford, 2004.
3. Behzad Razavi, *Design of Analog CMOS Integrated Circuits*, Tata McGraw Hill.
4. Adel S. Sedra and Kenneth C. Smith, *Microelectronic Circuits – Theory and Applications*, 5/e, Oxford University Press.

Internal Continuous Assessment *(Maximum Marks-50)*

50% - Tests (minimum 2)

30% - Assignments (minimum 2) such as home work, problem solving, quiz, literature survey, seminar, term-project, software exercises, etc.

20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

The question paper shall consist of 2 parts.

Part A (20 marks) - Ten Short answer questions of 2 marks each. All questions are compulsory. There should be at least two questions from each module and not more than three questions from any module.

Part B (80 Marks) - Candidates have to answer one full question out of the two from each module. Each question carries 20 marks.

Note: *Question paper should contain minimum 60% Design, Analysis and Problems.*

Course Outcome:

At the end of the course, the student shall be able to

- *Illustrate analog and digital models of MOS transistor.*
- *Design static logic circuits taking into account the threshold parameters in switching characteristics*
- *Design of classical two stage OPAMP and Comparators*
- *Identify the problems in dynamic circuits and Design of data converters (ADC and DAC) for specific applications.*
- *Use modern simulation tool in mixed signal design.*

13.607 MICROCONTROLLER LAB (T)

Teaching Scheme: 0(L) - 0(T) - 4(P) **Credits**: 4

Course Objective :

- *Practise Assembly Language Programs to perform simple mathematical and logical operations*
- *Understand interface experiments*

List of Experiments:

PART A : Programming experiments using 8051 Trainer Kit.

1. Addition of series of 8 bit binary and decimal numbers.
2. Subtraction of 2 decimal numbers.
3. Addition and subtraction of two 16 bit numbers.
4. Multiplication and division of 8 bit numbers.
5. Sorting of a series of 8 bit numbers.
6. Multiplication by shift and add method.
7. LCM and HCF of two 8 bit numbers.
8. Matrix addition
9. Square, Square root, Fibonacci series.
10. Other simple mathematical operations on 8-bit data.

PART B : Interfacing experiments.

1. DAC and ADC interface.
2. Stepper motor interface.
3. Display interface.
4. Realization of Boolean expression using port.
5. Waveform generation using lookup tables.
6. PWM generation.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - Test
40% - Class work and Record
20% - Regularity in the class

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Questions based on experiments prescribed in the list.

The following guidelines should be followed regarding award of marks

10% - Flow Chart/Algorithm

20% - Programming with suitable comments

10% - Implementation (Usage of Kits and trouble shooting)

35% - Result

25% - Viva voce

Candidate shall submit the certified fair record for endorsement by the external examiner.

Course Outcome:

The student shall be familiar to

- *Assembly Language Programming to execute simple mathematical and logical operations*
- *Perform interface experiments*

13.608 ELECTRONIC PRODUCT DESIGN & MINI PROJECT (AT)

Teaching Scheme: 1(L) - 0(T) - 3(P) **Credits**: 4

Course Objective :

- *Explain the stages of product development process.*
- *Predict the reliability of electronic products.*
- *Design electronic products considering safety aspects and hazardous environment.*
- *Assemble electronic circuits using modern hardware after simulation the circuit.*
- *Construct products considering environmental safety and sustainable development.*

This course includes both theory and practical works

I.THEORY

Theory classes are to be conducted 1 hour/week, based on the following syllabus:

DESIGN (Theory only)

Definition of a product, New Product development process. Creativity techniques. Elements of aesthetics. Ergonomics. Control panel organization. Electronic systems and needs. Physical integration of circuits, packages, boards and full electronic systems. Introduction to reliability, Reliability considerations in electronic products, Effect of reliability on product design and pricing. EMI and RFI studies. Restriction of Hazardous Substances compliance.

References:

1. Kaduskar and Baru, *Electronic Product Design*, Wiley India, 2012.
2. Kevin Otto and Kristin Wood, —*Product Design,* Pearson Education, 2003.
3. Flurschiem CH: *Industrial Design and Engg.*, Design Council, London and Springer Verlag, 1983.
4. Ernest J Mccormick: *Human Factors in Engg. And Design,* McGraw Hill, 2009.

II. PRACTICAL

A) Computer Aided PCB Design & Assembling

(One hour per week is allotted for Computer Aided PCB Design & Assembling.)

Following Circuits are to be used for the above purpose (Minimum one circuit from each category should be done)

1. Discrete component circuits.
2. Timer ICs and Op-Amp ICs based circuits.
3. Digital ICs based circuits.
4. Microcontroller based circuits.
5. Combination of the above.

B) MINIPROJECT

For Mini project, 2 hours/week is allotted.

Each student should conceive, design, develop and realize an electronic product. The basic elements of product design - the function ergonomics and aesthetics - should be considered while conceiving and designing the product. The electronic part of the product should be an application of the analog & digital systems covered up to the 6th semester.

The realization of the product should include design and fabrication of PCB. The student should submit a soft bound report at the end of the semester. The product should be demonstrated at the time of examination.

Internal Continuous Assessment *(Maximum Marks-50)*

40% - An end semester written examination is to be conducted based on the Theory part (Design), with two hour duration for 20 Marks.

40% - 20 marks is to be awarded for the Mini project, after evaluation at the end of the semester including project report.

20% - 10 marks for the attendance.

University Examination Pattern:

Examination duration: 3 hours *Maximum Total Marks: 100*

Practical examination will be conducted for Computer Aided PCB Design & PCB Assembling based on the work done in the class. The mini project will also be evaluated during the practical examination.

The following guidelines should be followed regarding award of marks

15% - PCB Design (any given circuit using CAD software) -

20% - PCB assembling of the given circuit on a single sided given PCB -

15% - Result/working of the assembled circuit -

25% - Evaluation of the finished Mini project done by the student -

25% - Viva voce (Based only on the Mini Project done by the student) -

Candidate shall submit the certified fair record and the mini project report (Soft bounded) for endorsement by the external examiner.

Course Outcome:

At the end of the course, the student shall be able to

- *Identify and decide the stages of product development process.*
- *Design and construct reliable electronic products considering safety aspects.*
- *Assemble electronic circuits using modern hardware after simulation the circuit.*