UNIVERSITY OF KERALA

B. TECH. DEGREE COURSE

(2013 SCHEME)

SYLLABUS FOR

VI SEMESTER

APPLIED ELECTRONICS and INSTRUMENTATION ENGINEERING

SCHEME -2013

VI SEMESTER

APPLIED ELECTRONICS and INSTRUMENTATION ENGINEERING (A)

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	Programming in C++ and Data Structures (A)	4	2	-	2	50	3	100	150
13.603	Process Dynamics & Control (A)	4	3	1	-	50	3	100	150
13.604	Biomedical Instrumentation (A)	3	2	1	-	50	3	100	150
13.605	Analog & Digital Communication (A)	4	3	1	-	50	3	100	150
13.606	Elective II	3	2	1		50	3	100	150
13.607	Microcontroller & Embedded Systems Lab (A)	4	-	-	4	50	3	100	150
13.608	Electronic Product Design & Mini Project (AT)	4	1	-	3	50	3	100	150
	Total	**29**	**15**	**5**	**9**	**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	Optimization Techniques (A)
13.606.7	Electromagnetics (A)

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, Addition – 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 PROGRAMMING IN C++ AND DATA STRUCTURES (A)

Teaching Scheme: 2(L) - 0(T) - 2(P) **Credits**: 4

Course Objective:

- *To learn and practice concepts of object oriented programming*
- *To learn about various data structures.*

Module – I

Basic stricture of a C++ program, Types and Declarations: Types - Boolean, character, integer, Floating point, void, enumerated. Conditional statements and loops. Declarations-structure, multiple names, scope, initialization. Function declaration, argument passing, value return. Recursive functions. Macros. Classes - objects, private, public and protected variables. Arrays (one and two dimensional). Pointers, new operator and delete operator for dynamic memory management. Pointer to arrays, constants, reference, pointer to void, pointer to function.

Module – II

Function overloading, operator overloading, friend function, derived class (inheritance), polymorphism, virtual function, templates, Files and streams. Library functions for File and String operations. Introduction to Standard Template Library. Programming tools- make files, debuggers, revision control systems, exception handling.

Module – III

Data Structures: Linked (single and double) lists -basic operations. Linked list implementation of Stack -basic operations, Queues - basic operations. Binary Tree- basic operations. Binary Search Tree, Binary tree traversal (in order, preorder, post order).

Module – IV

Sorting Algorithms- bubble sort, shell sort, merge sort, quick sort, heap sort. Comparison of Sorting algorithms by Speed and Space. Order (Big-O), Average, Best, Worst case running time of Algorithms..

References:

1. Stroustrup B, *The C++ Programming Language*, 3/e, Edition, Addison Wiley.
2. Aho A V and JD Ullman, *Data Structures and Algorithms*, Pearson Education, 2005.
3. Samenta D, *Classic Data Structures*, PHI, 2005.
4. Balaguruswamy E, *Object Oriented Programming with C++*,3/e, TMH.

5. Richard F Gilbert, Behrouz A Forouz, *Data Structures A Pseudocode Approach with C++*, Thomson, 2001.
6. Langsam, *Data Structures Using C and C++*, 2/e, Pearson Education.
7. Brain W Kernighan, *The Practice of Programming*, Pearson Education, 2007.
8. Bruce Eckel, *Thinking in C++,* volume I and volume II, Pearson Education, 2001.

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 the course, students will be familiar with data structures and they will develop skills in object oriented programming.

13.603 PROCESS DYNAMICS & CONTROL (A)

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

Course Objectives:

- *To learn about various processes and controllers*
- *To learn different control elements and controlling methods*

Module – I

Process Control System: Terms and objectives, piping and Instrumentation diagram, instrument terms and symbols. Regulator and servo control, classification of variables.

Process characteristics: Process equation, degrees of freedom, modelling of simple systems – thermal, gas, liquid systems. Process lag, load disturbance and their effect on processes. Self-regulating processes, interacting and non-interacting processes.

Module – II

Controller Modes: Basic control action, two position, multiposition, floating control modes. Continuous controller modes: proportional, integral, derivative. Composite controller modes: P-I, P-D, P-I-D, Integral wind-up and prevention., Auto/Manual transfer, Bumpless transfer. Response of controllers for different test inputs. Selection of control modes for processes like level, pressure, temperature and flow.

Module – III

Controller tuning Methods: Evaluation criteria - IAE, ISE, ITAE. Process reaction curve method, continuous oscillation method, damped oscillation method. Auto tuning. Closed loop response of I & II order systems, with and without valve, measuring element dynamics.

Advanced control system: Cascade control, ratio control, feed forward control. Over-ride, split range and selective control. Multivariable process control, interaction of control loops.

Module – IV

Final control elements: Pneumatic control valves, construction details, types, various plug characteristics. Valve sizing. Selection of control valves. Inherent and installed valve characteristics. Cavitation and flashing in control valves.

Valve actuators and positioners. Instrument air supply specifications. Case Studies: Steam boiler – drum level control and combustion. Distillation column – Modelling – Dynamics – Control of top and bottom product compositions – Reflux ratio. Control of chemical reactor – Control of heat exchangers.

References:

1. George Stephenopoulos: *Chemical Process Control*, 2/e, PHI.
2. Seborg D E et.al.: *Process Dynamics & Control*, Wiley, 1986.
3. Peter Harriot: *Process Control*, TMH, 1985.
4. Conghanowr D R: *Process Systems Analysis and Control*,2/e, McGraw Hill.
5. Carlos A Smith et.al: *Principles & Practice of Automatic Process Control*, 2/e, John Wiley & Sons.
6. B. Wayne Bequette: *Process Control – Modeling, Design and Simulation*, PHI, 2006.
7. Shinskey: *Process Control Systems*, 4/e, McGraw Hill.
8. Paul W.Murril: *Fundamentals of Process Control Theory*, 3/e, ISA press, New York.
9. W Luyben: *Process Modeling, Simulation and Control for chemical Engineers*, 2/e, McGraw Hill.
10. Patranabis D: *Principles of Process Control*, TMH, 1981.

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 the course, the students will be familiar with various processes and controllers, control elements and controlling methods.

13.604 BIOMEDICAL INSTRUMENTATION (A)

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

Course Objectives:

- *To familiarize terminology used in biomedical engineering*
- *To give an understanding of working of various instruments used in medical fields*
- *To study the recent trends in biomedical engineering*

Module – I

Electro physiology - Review of physiology and anatomy, resting potential, action potential, bioelectric potentials, cardiovascular dynamics, electrode theory, bipolar and unipolar electrodes, surface electrodes, physiological transducers. Systems approach to biological systems. Bioelectric potential and cardiovascular measurements - EMG - Evoked potential response, EEG, foetal monitor. ECG phonocardiography, vector cardiograph, BP, blood flow cardiac output, plethysmography, impedance cardiology, cardiac arrhythmia's, pace makers, defibrillators.

Module – II

Respirator and pulmonary measurements and rehabilitation - Physiology of respiratory system, respiratory rate measurement, artificial respirator, oximeter, hearing aids, functional neuromuscular simulation, physiotherapy, diathermy, nerve stimulator, artificial kidney machine.

Module – III

Patient monitoring systems - Intensive cardiac care, bedside and central monitoring systems, patient monitoring through bio-telemetry, implanted transmitters, telemetering multiple information. Sources of electrical hazards and safety techniques.

Module – IV

Recent trends- Medical imaging, X-rays, laser applications, ultrasound scanner, echo cardiography, CT Scan MRI/NMR, cine angiogram, colour doppler systems, Holter monitoring, endoscopy. Bioinformatics – Introduction, protein information resources, genome information resources, DNA sequence analysis, Pairwise alignment techniques.

References:

1. Leslie Cromwell, Fred J. Weibell and Erich A. Pfeiffer, *Biomedical Instrumentation and Measurements*, 2/e, PHI.

2. Joseph J Carr& John M Brown, *Introduction to Biomedical Equipment Technology*, 4/e, Pearson Education.
3. Attwood T. K. & D J Pary Smith, *Introduction to Bioinformatics*, Pearson Education, 2006.
4. Geddes L. A. and Baker L. E., *Principles of Applied Biomedical Instrumentation*, 3/e, John Wiley.
5. Khandpur R. S, *Handbook of Biomedical Instrumentation*, 2/e.TMH.
6. Ratner B.D. and Hoffman, *Biomaterials Science-An Introduction to Materials in Medicine*, 2/e, Elsevier.

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:

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 the completion of this course, students will be familiarized with medical imaging equipment and techniques. Construction and physiology of measurement and monitoring devices will also be familiarized as a part of this course.

13.605 ANALOG & DIGITAL COMMUNICATION (A)

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

Course Objective:

- *To learn fundamental aspects of analog and digital communications*
- *To learn about relative merits and demerits of analog and digital communication systems*

Module – I

Amplitude modulation - Modulation Index, Modulation Index for Sinusoidal AM, Average power for sinusoidal AM, Effective Voltage and Current for Sinusoidal AM, DSBSC Modulation, Amplitude Modulator Circuits, Amplitude Demodulator Circuits, Diagonal Peak Clipping, AM Transmitters – Broadcast Transmitters.

Receivers – Super hetero dyne Receivers, Tuning Range, Tracking, Sensitivity and Gain, Image Rejection, Adjacent Channel Selectivity, Automatic Gain Control, Double Conversion. Single Sideband Modulation - Principles, Balanced Modulators –SSB Generation – Filter Method, Phasing Method & Third Method, SSB Reception, Pulse Modulation - PAM - TDM, PPM, PWM.

Module – II

Angle Modulation - Frequency modulation, Sinusoidal FM, Frequency spectrum for sinusoidal FM, Average power in sinusoidal FM, Non-sinusoidal modulation-deviation ratio, Phase modulation- Equivalence between PM and FM, Sinusoidal Phase Modulation, Angle modulator Circuits – Varactor Diode Modulators, Transistors Modulators, FM Transmitters – Direct & Indirect Methods, FM Broadcast, Angle modulation detectors – Foster-Seeley discriminator, Ratio Detector, PLL Demodulator, Automatic Frequency Control, Amplitude Limiters, Pre-emphasis and De-emphasis.

Module – III

Pulse Modulation- Sampling process, Aliasing, Reconstruction, PAM, Quantization, PCM, Noise in PCM system, Modifications of PCM – Delta modulation, DPCM, ADPCM, ADM, Processing Gain. 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, Base band M-ary PAM transmission, eye pattern, optimum linear receiver. Adaptive Equalization.

Module – IV

Spread spectrum communication - Pseudo–noise sequences, Properties of PN sequences. Generation of PN Sequences, generator polynomials, Maximal length codes and Gold Codes. Spread spectrum communication– Notion of spread spectrum, Direct sequence spread

spectrum with coherent binary phase shift keying, Signal space dimensionality and processing gain, Diversity techniques - Diversity in time, frequency and space. TDMA and CDMA.

References:

1. Simon Haykin, *Communication systems*, 4/e, John-Wiley & Sons.
2. Dennis Roody and John Coolen, *Electronic Communication*, 4/e, PHI.
3. Wayne Tomasi, *Advanced Electronic Communications Systems*, 6/e, PHI.
4. Bernard Sklar, *Digital Communication*, 2/e, Pearson Education, 2001.
5. Harold Kolimbris, *Digital Communication Systems*, 1/e, Pearson Education, 2000.
6. Sam Shanmugham, *Digital and Analog Communication systems*, Wiley India.
7. Leon W. Couch II, *Digital and Analog Communication Systems*, 6/e, Pearson Education.
8. John G. Proakis, MasoudSalehi: *Communication Systems Engineering*, 3/e, Pearson Education
9. John G. Proakis & MasoudSalehi: *Communication Systems Engineering*, 6/e, Pearson Education.
10. George Kennedy,*Communication Systems*, 3/e, TMH.
11. Leon W. Couch II, *Digital and Analog Communication Systems*, 6/e, Pearson Education.
12. Raveendranathan K. C., *Analog Communications Systems-Principles and Practice,* Universities Press, 2008.

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:

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 the completion of this course, the students will be familiarized with fundamentals of analog and digital communication systems. They will able to compare analog and digital communication systems in terms of their requirements and performance.

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 (1978), Prentice Hall.
2. Flanagan J.L., Speech Analysis Synthesis and Perception (2/e), 1983, Berlin.
3. Witten I.H., Principles of Computer Speech (1982), Academic 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.

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 modeling of a multi-path communication channel, adaptive model in geophysical exploration, Inverse modeling, Adaptive interference canceling: 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 OPTIMIZATION TECHNIQUES (A) (Elective II)

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

Course Objectives:

To learn concepts of linear programming and the methods of optimization.

Module – I

Unconstrained optimization: Necessary and sufficient conditions for local minima, One dimensional search methods, Gradient methods - Steepest descent, Inverse Hessian, Newton's method, Conjugate direction method, Conjugate gradient algorithm, Quasi Newton methods.

Module – II

Linear Programming: Convex polyhedra, Standard form of linear programming, Basic solutions, Simplex algorithm, Matrix form of the simplex algorithm, Duality, Non simplex methods: Khachiyan method, Karmarkar's method.

Module – III

Nonlinear Constrained Optimization: - Equality constraints – Lagrange multipliers, Inequality constraints -Kuhn-Tucker conditions, Convex optimization, Geometric programming, Projected gradient methods, Penalty methods.

Module – IV

Genetic Algorithms - basics, design issues, convergence rate, Genetic Algorithm methods.

References:

1. Edwin K. P. Chong, Stanislaw H. Zak, *An Introduction to Optimization*, 2/e, John Wiley & Sons.
2. Stephen Boyd, Lieven Vandenberghe, *Convex Optimization*, CUP, 2004.
3. R. Fletcher, *Practical methods of Optimization*, 2/e, Wiley, 2003.
4. Belegundu, *Optimization Concepts and Applications in Engineering*, Pearson Education, 2005.

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:

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 the completion of this course, students will be familiar with various optimization techniques and their areas of application..

13.606.7 ELECTROMAGNETICS (A) (Elective II)

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

Course Objective:

- *To learn fundamentals of electromagnetic theory*
- *To learn applications of electromagnetic theory in antenna design and wave propagation*

Module – I

Review of vector geometry – Spherical and cylindrical coordinate systems- Maxwell's equations, TEM modes in a linear homogenous isotropic medium, polarization, Pointing vector and power flow, TEM waves incident on a boundary - Snell's laws, wave propagation inside a conductor -skin depth, phase and group velocity.

Module – II

Multi-conductor Transmission Lines - Time-domain analysis of transmission lines, Frequency-domain analysis of transmission lines, Standing waves; Transmission line matching, Single stub matching, quarter-wave transformers.

Module – III

Waveguides - Electromagnetic fields in parallel-plate, rectangular waveguides, TE and TM modes, wave impedance, wave velocities, attenuation in waveguides. Electromagnetic radiation, retarded potentials, power density, beam solid angle, radiation intensity, radiation resistance, radiation pattern, radiation efficiency, gain, directivity, effective aperture and effective length of the antennas.

Module – IV

Electric field, magnetic field, radiation resistance and directivity of short dipole and half wave dipole. Folded dipole, Yagi-Uda, Parabolic dish antenna. Antenna arrays – broadside and end-fire array.
Wave Propagation – Ground wave, Sky wave and Space wave propagation.

References:-

1. Ramo S., Whinnery J. R., and T. Van Duzer, *Fields and Waves in Communication Electronics*, 3/e, Wiley Eastern.
2. Nannapaneni Narayana Rao: *Elements of Engineering Electromagnetics*, 5/e, Pearson Education.
3. Jordan, E.C. and Balmain, K.G., *Electromagnetic Waves and Radiating Systems*, 2/e, PHI.
4. Sadiku, M.N.O., *Elements of Electromagnetics*, 3/e, Oxford University Press.
5. Collin R.E., *Foundations for Microwave Engineering*, 2/e, McGraw-Hill, 1993.

6. Hayt, W.H. and Buck, J.A., *Engineering Electromagnetics*, 7/e, Tata McGraw-Hill, 2006.
7. John D. Kraus, *Electromagnetics*, 4/e, McGraw Hill.
8. David K. Cheng, *Field and Wave Electromagnetics*, 2/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:

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 the completion of this course, the students will be familiar with the fundamentals of electromagnetic theory and its area of applications.

13.607 MICROCONTROLLER & EMBEDDED SYSTEMS LAB (A)

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

Course Objectives:

- *To develop microcontroller programming skills*
- *To learn interfacing of various peripherals to microcontroller*

List of Experiments:

Part A : Programming experiments using 8051 Trainer Kit.

1. Addition and Subtraction of 16 bit numbers.
2. Multiplication and division of 8 bit numbers.
3. Sorting, Factorial of a number.
4. Multiplication by shift and add method.
5. LCM and HCF of two 8 bit numbers
6. Matrix addition
7. Square, Square root, Fibonacci series.

Part B: Interfacing experiments

1. DAC interface.
2. Stepper motor interface.
3. Display interface.
4. Realization of Boolean expression using port.
5. Frequency measurement by counting the number of pulses in a fixed amount of time.
6. Frequency measurement by measuring the time period between two consecutive pulses.
7. Waveform generation using lookup tables.
8. PWM generation.
9. Interfacing with 8-bit ADC.

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 for each batch should be based on the list of experiments prescribed, equally from Part A and Part B.

25% - Circuit Design

15% - Implementation (Usage of Kits and trouble shooting, Coding for Software experiments)

35% - Result

25% - Viva voce

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

Course Outcome:

After the completion of this course, the students will be familiar with microcontroller programming. They will also be familiar with interfacing various peripherals to the microcontroller.

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 6^{th} 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.*