Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

(Accredited 'A' Grade by NAAC with a score of 3.25)

Hingna Road, Wanadongri, Nagpur - 441 110

SoE & Syllabus 2018-19

M. Tech. Communication Engineering

28 June 2018

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2018-19

Communication Engineering

SN	Sem	Sub Code	Subject	T/P	Contact				Credits	% Weightage				ESE Duration
					L	T	P	Hrs		MSE-I	MSE-II	TA	ESE	
I SEMESTER														
1	1	ET2901	Mathematical Foundations for Communication Engineering	T	3	0	0	3	3	15	15	10	60	3
2	1	ET2902	Passive RF Circuits & Systems	T	3	0	0	3	3	15	15	10	60	3
3	1	ET2903	**Lab:** Passive RF Circuits & Systems	P	0	0	2	2	1			40	60	
4	1	ET2904	Advanced Digital Communication	T	3	0	0	3	3	15	15	10	60	3
5	1	ET2905	Lab: Advanced Digital Communication	P	0	0	2	2	1			40	60	
6	1	ET2906	Adaptive Signal Processing	T	3	0	0	3	3	15	15	10	60	3
7	1	ET2907	**Lab:** Adaptive Signal Processing	P	0	0	2	2	1			40	60	
8	1		**Professional Elective- I**	**T**	3	0	0	3	3	15	15	10	60	3
Total					**15**	**0**	**6**	**21**	**18**					

List of Professional Electives-I		
1	ET2908	PE I: Error Control Coding
1	ET2909	PE I: Embedded Systems & DSP Processor
1	ET2910	PE I: Pattern Recognition

II SEMESTER

1	2	ET2911	Advanced Antenna Theory	T	3	0	0	3	3	15	15	10	60	3
2	2	ET2912	**Lab:** Advanced Antenna Theory	P	0	0	2	2	1			40	60	
3	2	ET2913	VLSI Signal Processing	T	3	0	0	3	3	15	15	10	60	3
4	2	ET2914	Digital Image processing	T	3	0	0	3	3	15	15	10	60	3
5	2	ET2915	**Lab:** Digital Image processing	P	0	0	2	2	1			40	60	
6	2	ET2916	Wireless Communications & Networks	T	3	0	0	3	3	15	15	10	60	3
7	2		**Professional Elective -II**	T	3	0	0	3	3	15	15	10	60	3
8	2	ET2921	Seminar	P	0	0	2	2	1			100		
Total					**15**	**0**	**6**	**21**	**18**					

List of Professional Electives-II		
2	ET2917	PE II: Selected Topics in Communication Systems
2	ET2918	PE II: Speech Processing
2	ET2919	PE II: Detection & Estimation Theory
2	ET2920	PE II: Real Time Operating System

III SEMESTER

1	3		**Professional Elective- III**	T	3	0	0	3	3	15	15	10	60	3
2	3		**Professional Elective-IV**	T	3	0	0	3	3	15	15	10	60	3
3	3	ET2937	Project Phase-I	P	0	0	16	16	8			100		
Total					**6**	**0**	**16**	**22**	**14**					

List of Professional Electives-III		
3	ET2931	PE III: Multimedia Communications
3	ET2932	PE III: Active RF Devices and Circuits
3	ET2933	PE III: Soft Computing

List of Professional Electives-IV		
3	ET2934	PE IV: High Speed Networks
3	ET2935	PE IV: Wireless Sensor Networks
3	ET2936	PE IV: Micro Electro Mechanical Systems

IV SEMESTER

1	4	ET2940	Project Phase-II	P	0	0	24	24	12		40	60	
Total					**0**	**0**	**24**	**24**	**12**				
Grand Total of Credits									62				

		June 2018	**1.00**	**Applicable for Sem 1 & 2 AY 2018-19 & Sem 3 & 4 AY 2019-20 Onwards**
Chairperson	**Dean (Acad. Matters)**	**Date of Release**	**Version**	

I Semester

ET2901	Mathematical Foundations for Communication Engineering	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
To introduce the fundamentals of probability theory and random processes and illustrate these concepts with Communication engineering applications such as signal processing and digital communications.

UNIT-1:
Definitions, limitations of classical and relative-frequency-based definitions. Sets, fields, sample space and events; axiomatic definition of probability. Combinatory: Probability on finite sample spaces. Joint and conditional probabilities, independence, total probability; Bayes' rule and applications

06Hrs

UNIT-2:
Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf); probability density functions (pdf) and properties. Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables.

06Hrs

UNIT-3
Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution
Functions of a random variable, Functions of two random variables; Sum of two independent random variables.

06Hrs

UNIT-4:

Expectation: mean, variance and moments of a random variable. Joint moments, conditional expectation, Moment-generating and characteristic functions and their applications, Bounds and approximations:. Schwarz Inequality, Chebyshev inequality and Chernoff Bound, Central limit theorem and its significance.

06Hrs

UNIT-5
Random vector: Joint distribution and densities, multiple transformation, mean vector, covariance matrix and properties, simultaneous, characteristic functions of random vectors, parameter estimation

06Hrs

UNIT-6:
Basic definitions, important Random processes, continuous-time linear systems with random inputs white noise, classification of random processes, WSS processes and LSI systems.

06Hrs

Text books:

1	Probability and Random Processes	2002	H. Stark, J.W Woods	Pearson Education
2	Probability, Random Variables and Stochastic Processes	2002	A. Papoulis, S. U. Pillai,	McGraw Hill

Reference books:

1	Probability and Stochastic Processes	1992	R D Yates, D J Goodman	John Wiley and Sons

I Semester

ET2902	Passive RF Circuits and Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
To understand and study the design of RF circuits in communication systems. This course will help in Resonator and RF Filter designing, Study of RF Active components.

UNIT-1:Review of Basic Transmission Line Theory, Planar Transmission Lines - Stripline, microstrip line, Suspended strip line and coplanar line; Parallel coupled lines in Stripline and microstrip – Analysis, Design and characteristics.

06 Hrs

UNIT-2:
Microwave Network Analysis - Microwave network representation, Impedance and admittance matrices, Scattering parameters, Typical two-port, three port, four port networks; Impedance Matching Techniques - Smith chart, Matching networks using lumped elements, Single- and double-stub matching, Quarter wave transformer, Baluns

06 Hrs

UNIT-3
Basic Passive Components -Lumped elements in MIC, Discontinuities and resonators in microstrip, Analysis and design of Stripline/microstrip components- Directional couplers, Power divider, Hybrid ring.

06 Hrs

UNIT-4:
Switches and Phase Shifters Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branch line coupled and loaded line phase shifters in microstrip, Applications in phased arrays.

06 Hrs

UNIT-5
MIC Filters - Lumped element filter design at RF. Impedance and Low pass scaling, Frequency transformation, High impedance/Low impedance low pass filter, Parallel coupled band pass filter, High pass filter, bandstop filter

06 Hrs

UNIT-6:
Basics of MIC, MMIC and MEMS technologies - Substrates used.

06 Hrs

Text books:

1 Radio Frequency and Microwave Electronics 2001 M.M. Radmanesh, Pearson Education Asia,

2 Stripline-like Transmission Line for Microwave Integrated Circuits, 1989. B. Bhat& S.K. Koul New Age Intl. (P) Ltd.,

Reference books:

1 Radio Frequency and Microwave Communication Circuits – Analysis and Design, 2001. D. K. Misra, John Wiley & Sons,

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I Semester

ET2903	Lab: Passive RF Circuits and Systems	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

Ten Experiments based on

1. **Low Pass, Band Pass, Band Stop Filters**
2. **Couplers**
3. **Phase Shifter**
4. **Power Divider**
5. **Hybrid ring Coupler**
6. **Switches**

I Semester

ET2904	Advanced Digital Communication	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:

This course discusses the principles that underline the analysis and design of digital communication systems. The focus is on the reliable transmission and reception of symbols over noisy channels. The students will explore linear and nonlinear modulation techniques, various channels like AWGN and fading, Synchronization techniques, Equalization techniques and MIMO channels

UNIT-1: Review of fundamental concepts and parameters in Digital Communications, Performance of BPSK and QPSK in AWGN channel, Performance of binary FSK and M-ary PSK in AWGN channel.

06 Hrs

UNIT-2:

Minimum Shift Keying (MSK) Modulation, GMSK, Continuous Phase Modulation (CPM) Schemes Channel Characterization and Modeling, Orthogonal Frequency Division Multiplexing (OFDM), Carrier Synchronization, Timing synchronization.

06 Hrs

UNIT-3

Representations of band pass signal and systems, signal space representation, representation of digitally modulated signals, spectral characteristics of digitally modulated signals.

06 Hrs

UNIT-4:

Baseband reception and probability of error, the ML and MAP detection strategies, ML detection with zero mean AWGN,the optimum filter, Schwarz's inequality, transfer function of optimum filter, matched filter, properties of Matched filter, correlation receiver,equalization,the zero forcing equalizer, adaptive equalizer, scrambling, the eye pattern.

06 Hrs

UNIT-5

Spread spectrum signals for digital communications: Introduction to Spread Spectrum Modulation, DSSS, FHSS, and CDMA signals, Code Acquisition and Tracking, Spread Spectrum as a Multiple Access Technique.

06 Hrs

UNIT-6:

Multichannel and Multicarrier Systems; Digital Communications through Fading Multipath channels; Multi User Communications.

06 Hrs

Text books:

1	Digital Communications	1995 4th Edition	J.G.Proakis	McGraw Hill,
2	Digital Communications	1998	Simon Haykin	John Wiley & Sons

Reference books:

1	Principles of Digital Communications and Coding	1979	J. Viterbi and J. K. Omura	McGraw Hill,
2	Spread Spectrum Communications	1995.	MarvinK.Simon,Jim K Omura, RobertA. Scholtz, Barry K.Levit	John Wiley & Sons
3	CDMA Principles of Spread Spectrum Communications	1995.	Andrew J Viterbi	Addison Wesley

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I Semester

ET2905	**Lab : Advanced Digital Communication**	**L=0**	**T=0**	**P=2**	**Credits=1**

Evaluation Scheme	**Continuous Evaluation**	**ESE**	**Total**	**ESE Duration**
	40	**60**	**100**	

Ten Experiments based on

1. **BPSK**
2. **QPSK**
3. **MSK**
4. **MIMO**
5. **OFDM**
6. **Channel Estimation**

I Semester

ET2906	Adaptive Signal Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
Advances in Digital Signal Processing involve variable sampling rates, applications in communication systems and signal processing. Linear adaptive filters are studied. It is intended to introduce a course in multirate signal processing, filtering and spectrum estimation.

UNIT-1:Wiener filtering. Optimum linear prediction. Levinson- Durbin algorithm. Prediction error filters.
06 Hrs

UNIT-2:
Adaptive filters. FIR adaptive LMS algorithm. Convergence of adaptive algorithms. Fast algorithms. Applications; Noise canceller, echo canceller and equalizer.
06 Hrs

UNIT-3
Transform domain adaptive filters, The orthogonalization property of orthogonal transforms, The transform domain LMS algorithm.
06 Hrs

UNIT-4:
Recursive least – squares algorithms. Matrix inversion lemma. Convergence analysis of the RLS algorithm.
06 Hrs

UNIT-5
Adaptive beam forming. Kalman filtering.
06 Hrs

UNIT-6:
Fast RLS algorithm, Least square forward prediction, Least square backward prediction, least square lattice, The RLS algorithm, The FTRLS algorithm. Case studies and Industrial Applications.
06 Hrs

Text books:

1	Adaptive Filters:Theory& Applications		B.FarhangBoroujeny	wiley Publication
2	Adaptive Filter Theory	1996,(3/e),	Simon Haykin	Prentice- Hall

Reference books:

1	Statistical and Adaptive Signal Processing	2005	D.G.Manolakis	McGraw-Hill,
2	Statistical Digital Signal Processing and Modeling		M.H.Hays,	John-Wiley.

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I Semester

ET2907	Lab : Adaptive Signal Processing	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

Ten Experiments based on

1. Random Number generator and finding correlation and autocorrelation
2. Wiener filter
3. LMS and NLMS
4. Adaptive equalizer
5. Linear predictor
6. RLS algorithm and fast algorithm

I Semester

ET2908	PE I: Error Control Coding	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
The purpose of the course is to present error correction/detection coding in a modern setting, covering both traditional concepts thoroughly as well as modern developments in soft-decision and iteratively decoded codes and recent decoding algorithms for algebraic codes.

UNIT-1:
Coding for reliable digital transmission and storage. Groups, Rings, Vector Spaces, Galois Fields, Polynomial rings.
06 Hrs.

UNIT-2:
Channel models, Linear Block codes, syndrome and error detection, the minimum distance of block code,standard array and syndrome decoding, Cyclic codes, polynomials , the division algorithm for polynomials,circuit implementation of cyclic codes.
06 Hrs.

UNIT-3
Convolution codes, decoding algorithms for Convolution codes, Viterbi, Stack algorithm, Fano algorithm, Application of Convolution codes.
06 Hrs.

Unit 4:
BCH codes, primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, Reed Solomon Codes, Berlekamp-Massey and Euclid decoding algorithm, Decoding beyond the minimum distance Parameter, Applications of Reed-Solomon codes.
06 Hrs.

UNIT-5
Trellis coded Modulation, Combinatorial description of Block and Convolution codes, mapping by set partitioning ,TCM design rule.
06 Hrs.

UNIT-6:
Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space-Time codes.
06 Hrs.

Text books:

1	Error Control Coding: Fundamentals and Applications	2003.	Shu Lin and Danicl J. Costello Jr	Prentice Hall,
2	Error Control Systems for Digital Communication and Storage	1995	S. B Wicker	Prentice- Hall

Reference books:

1	Theory and Practise of Error Control Codes	2003.	Shu Lin and Danicl J. Costello Jr	Prentice Hall,
2	Error Control Systems for Digital Communication and Storage	1983.	Blahut R. E	Addisson Wesley
3	Algebraic codes for Data transmission	2003	Blahut R.E	Cambridge University Press
4	Fundamentals of Convolutional codes	1999.	Johannesson R and Zigangirov K.S	IEEE press
5	Trellis structure of codes, Chapter 24 of Handbook of Coding Theory.		V. S Pless and W. C Huffman, A. Vardy	
6	Error Correction Coding-Mathematical methods & algorithms		Todd K Moon	Wiley

I Semester

ET2909	PE I: Embedded Systems & DSP Processor	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
The course introduces us with the basics of embedded systems, familiarity with the Optimizing Design Metrics, processor technology, IC technology, design technology, hardware, the software, peripherals, memory and interfacing and tradeoffs.

UNIT-1:
Embedded Systems, Introduction, Design Metrics, Processor Technology, IC Technology, Design Technology, Design Productivity Gap, Custom Single purpose Processor Design, RT level design, FSMD, Data-paths, Optimization, Instruction set simulators for simple processors.

06Hrs

UNIT-2:
Architectural Features Of ARM: Processor modes, Register organization, Exceptions and its handling,Memory, Memory-mapped I/Os, ARM and THUMB instruction sets, Addressing modes, DSP extensions, ARM sample codes

06 Hrs

UNIT-3
ARM7/9 Core: H/W architecture, Timing diagrams for Memory access, Co-processor interface, Debug support, Scan chains, Embedded Real Time ICE, Hardware and software breakpoints. Buses: AMBA, ASB, APB, Development tool like Compilers, Debuggers, IDE etc.

06Hrs

UNIT-4:
DSP Architecture: MAC, Modified bus structures and Memory access schemes, Multiple access Memory , Multi-ported memory, VLIW architecture, Pipelining, Special addressing modes, On chip peripherals.

06 Hrs

UNIT-5:
TMS320C3X -32 bit floating point DSP Processor: Introduction, features, Applications, Block diagram, Internal architecture, CPU & data paths, Functional units, Addressing modes, Memory architecture, External memory accesses, Pipeline operation, Peripherals.

06Hrs

UNIT-6:
Assembly language programming. Hardware tools: DSP and other DSP boards Software tools: Assembly language tools.

06Hrs

Text books:

1	ARM System Developer's Guide: Designing and Optimizing	2004	Sloss Andrew N, Symes Dominic, Wright Chris	Morgan Kaufman Publication
2	Digital signal processors	2002, 1st Edition	B. Venkataramani, M Bhaskar	Tata McGraw Hill

Reference books:

1	ARM System-on-Chip Architecture	2nd Edition,2002	Steve furber	Pearson Education
2	Embedded System Design	2002, 1st Edition	Frank Vahid and Tony Givargis	Wiely Publication
3	Embedded System Design	2003	Raj Kamal	Tata McGraw Hill ,

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I Semester

ET2910	PE I: Pattern Recognition	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
To equip with basic mathematical and statistical techniques commonly used in pattern recognition. To introduce to the various pattern recognition algorithms.

UNIT-1:
Introduction ,Applications of Pattern Recognition, Statistical Decision Theory,The Internet Pointers to the Literature, Problems
05Hrs

UNIT-2:
Probability, Probabilities of Events, Random Variables, Joint Distributions and Densities Moments of Random Variables ,Estimation of Parameters from Samples, Minimum Risk Estimators, Problems
06Hrs

UNIT-3
Statistical Decision Making
Introduction, Bayes' Theorem, Multiple Features, Conditionally Independent Features, Decision Boundaries ,Unequal Costs of Error ,Estimation of Error Rates ,The Leaving-One-Out Technique, Characteristic Curves, Estimating the Composition of Populations, Problems
07Hrs

UNIT-4:
Nonparametric Decision Making
Introduction , Histograms, Kernel and Window Estimators, Nearest Neighbor Classification Techniques, Adaptive Decision Boundaries, Adaptive Discriminant Functions , Minimum Squared Error Discriminant Functions, Choosing a Decision Making Technique, Problems
07Hrs

UNIT-5
Clustering
Introduction , Hierarchical Clustering, Partitional Clustering, Problems
07Hrs

UNIT-6:
Recent trends in Pattern Recognition
03 Hrs

Text books:

1	Pattern Recognition and Image Analysis	Earl Gose,Richard Johnsonbaugh		Printice Hall
2	Pattern Classification	2006	Richard O. Duda, Peter E. Hart and David G. Stork	2nd Edition, John Wiley,

Reference books:

1	Pattern Recognition and Machine Learning	2009	C. M. Bishop	Springer,
2	Pattern Recognition	2009	Theodoridis and K. Koutroumbas	4th Edition, Academic Press

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II Semester

ET2911	Advanced Antenna Theory	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
The course aims at basic principles and theory of antennas. It gives the latest developments and advances on antennas and its physical concepts are emphasized.

UNIT-1:
Fundamental Parameters of Antenna, Radiation Integrals & Auxillary Potential Function

06Hrs

UNIT-2:
Planar Antennas Microstrip rectangular and circular patch antennas. Analysis and design, Feeding Methods; Circularly polarized microstrip antennas, Broadbanding techniques. Printed slot antennas.

06Hrs

UNIT-3

Yagi array of linear elements and printed version, Log-periodic dipole array. Frequency Independent Antennas Planar spiral antenna,

06Hrs

UNIT-4:
Array Theory Linear array; Broadside and end fire arrays, Self and mutual impedance of between Linear elements, grating lobe considerations. Planar array, Array factor, beamwidth, directivity. Example of microstrip patches arrays and feed networks & analysis**.**

06Hrs

UNIT-5
Aperture Antennas- Field equivalence principle, Babinet's principle. Rectangular waveguide horn antenna, Parabolic reflector antenna. Uniqueness theorem

06Hrs

UNIT-6:
Antennas for mobile communication. Handset antennas: FIFA, Smart antennas, Switch beam system, Adaptive array system, Spatial Division Multiple Access.

06 Hrs

Text books:

1	Antenna Theory and Design	1997.	C. A. Balanis	John Wiley & Sons

Reference books:

1	CAD of Microstrip Antennas for Wireless Applications	1996.	R.A. Sainati	Artech House
2	Antenna design Handbook	1988	R. Garg, P. Bharhia, I. Bahl, and A. Ittipiboo	Artech House.
3	Microstrip Antennas: Theory & Design		J. R. James, P.S. Hall and C.Wood, , Peter Peregrinns	UK

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II Semester

ET2912	Lab : Advanced Antenna Theory	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

Sr. No. **Ten Experiments Based on**

1. Microstrip patch antenna
2. Slot Antenna
3. Yagi Uda Antenna
4. Log periodic Antenna
5. Horn Antenna
6. Antenna Arrays

II Semester

ET2913	VLSI Signal Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES

The students shall gain proficiency in subjects like the basic design of theory involved in VLSI for signal processing and communication systems , various software tools related to VLSI, Signal Processing and Communication Systems.

UNIT-1:

Introduction to DSP systems – Typical DSP algorithms, Data flow and Dependence graphs - critical path, Loop bound, iteration bound, longest path matrix algorithm, Pipelining and Parallel processing of FIR filters, Pipelining and Parallel processing for low power,

06Hrs

UNIT-2:

Retiming – definitions and properties. Unfolding – an algorithm for unfolding, properties of unfolding, sample period reduction and parallel processing application.

06Hrs

UNIT-3

Folding transformation, Register minimisation techniques Systolic architecture design, FIR systolic arrays, selection of scheduling vector, 2d systolic array design, systolic design for space representations containing delays.

06Hrs

UNIT-4:

Fast convolution – Cook-Toom algorithm, modified Cook-Toom algorithm

Pipelined and parallel recursive filters – Look-Ahead pipelining in first-order IIR filters, Look-Ahead pipelining with power-of-2 decomposition, Clustered look-ahead pipelining, Parallel processing of IIR filters, combined pipelining and parallel processing of IIR filters**.**

06 Hrs

UNIT-5

Bit-level arithmetic architectures – parallel multipliers with sign extension, parallel carry-ripple and carry-save multipliers, Design of Lyon's bit-serial multipliers using Horner's rule, bit-serial FIR filter, CSD representation, CSD multiplication using

Horner's rule for precision improvement

06 Hrs

UNIT-6:

Algorithmic strength reduction in filters and transforms – 2-parallel FIR filter, 2-parallel fast FIR filter, DCT architecture

Numerical strength reduction- subexpression elimination, multiple constant multiplication, iterative matching, sub-expression sharing in digital filters, additive and multiplicative number splitting

06 Hrs

Text books:

1	VLSI Digital Signal Processing Systems, Design and implementation	2007 1st Edition	Keshab K. Parhi	Wiley Interscience,.

Reference books:

1	"Digital Signal Processing with Field Programmable Gate Arrays".	2nd Edition, 2004	U. Meyer- Bease,	Springer,

II Semester

ET2914	Digital Image Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:

Objectives of the course is to provide an introduction to basic concepts and methodologies for digital image processing, and to develop a foundation that can be used as the basis for further study and research in this field. Concepts of video and standards are introduced.

UNIT-1:

Digital image fundamentals – image acquisition, representation, visual perception, quality measures, Sampling and quantization, basic relationship between pixels, imaging geometry, color spaces, Image enhancement – point processing, spatial domain filtering.

06 Hrs

UNIT-2:

Image transforms - DFT, DCT, Haar, KL transform, Wavelets and multiresolution processing, Sub-band coding, Multiresolution expansion, One dimensional wavelet transform, Wavelet series expansion, Discrete wavelet transform, Continuous wavelet transform, fast wavelet transform, 2-D wavelet transform, Wavelet packets.

06 Hrs

UNIT-3

Frequency domain filtering, Image restoration/degradation model, Restoration-spatial domain filtering, Periodic Noise Reduction by Frequency Domain filtering, Motion debluring, Estimation the degradation function, Inverse filtering, Minimum Mean Square Error (Wiener Filtering),Constrained Least square filter**.**

06 Hrs

UNIT-4:

Image compression – Data redundancy, lossless and lossy compression techniques, standards for image compression – JPEG, JPEG2000.

06 Hrs

UNIT-5

Image Segmentation-The detection of Discontinuities: Point, Line and Edge Detections :Gradient Operators and Laplacian, Edge linking and Boundary detection : Local Processing and Global Processing Via Hough Transform, Thresholding. Region based segmentation, Clustering technique, Active Contour.

06 Hrs

UNIT-6:

Representation Schemes, Chain Codes, Polygon Approximation, signatures, Skeleton, Boundary Descriptors: Simple Descriptors, Shape Numbers, Fourier Descriptors, Region Descriptor: statistical moments, simple descriptor, Topological descriptor, Texture, Dilation and erosion, opening and closing hit-or-miss transformation, morphological algorithms.

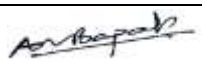
06Hrs

Text books:

1	Digital Image Processing	2002	R. C. Gonzalez and R E Woods	Pearson Education
2	Digital Image Processing		S. Jayaraman, S. Esakkirajan, T Veerakumar	McGraw-Hill

Reference books:

1	Fundamentals of Digital Image Processing	1989	A K Jain	Pearson Education
2	Digital Image Processing	2001	W Pratt	Wiley

		June 2018	1.00	Applicable for Sem 1 & 2 AY 2018-19 & Sem 3 & 4 AY 2019-20 Onwards
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II Semester

ET2915	Lab : Digital Image Processing	L=0	T=0	P=2	Credits=1

Evaluation Scheme	Continuous Evaluation	ESE	Total	ESE Duration
	40	60	100	

Sr. No.	Ten Experiments Based on
1.	Image Enhancement & Spatial Domain Filtering
2.	Image Transforms
3.	Frequency Domain Filtering
4.	Image Compression
5.	Image Segmentation
6.	Morphological Operations

II Semester

ET2916	Wireless Communications & Networks	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:

This course provides an authoritative treatment of the fundamentals of mobile communications, one of the fastest growing areas of the modern telecommunications industry. It stresses the fundamentals of mobile communications engineering and the networks that are important for the design of any mobile system.

UNIT-1:

Radio Propagation Characteristics: Reflection, diffraction and Scattering, Models for path loss, shadowing and multipath fading (delay Spread, coherence band width, coherence time, Doppler spread), Multipath Fading Models.

06 Hrs

UNIT-2:

Diversity**:** Realization of Independent Fading Paths ,Diversity System Model , Selection Combining , Threshold Combining , Maximal Ratio Combining, Equal-Gain Combining ,Moment Generating Functions in Diversity Analysis , Diversity Analysis for MRC , Diversity Analysis for EGC and SC , Diversity Analysis for Noncoherent and Differentially Coherent Modulation , Transmitter Diversity

06 Hrs

UNIT-3

Multicarrier Modulation , Fading across Subcarriers , Frequency Equalization , Precoding , Adaptive Loading ,Coding across Sub channels RAKE receivers ,

06 Hrs

UNIT-4.:

Multiple access techniques for wireless communication: SDMA ,Packet radio protocols: Pure & Slotted ALOHA,CSMA

06 Hrs

UNIT-5:

Wireless Systems and Standards: GSM-GSM services and features, Architecture, Radio Subsystem, GSM channel types, Frame structure and signal processing in GSM, CDMA-Forward CDMA channel, Reverse CDMA channel

06 Hrs

UNIT-6:

3G Overview, 3GPP Network Architecture, 4G features and challenges, Introduction to wireless LANs - IEEE 802.11 WLANs, Blue tooth , Wi-Max, Zigbee

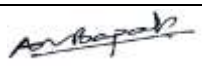
06 Hrs

TEXTBOOK

1	Wireless communications	2003.	Rappaport. T.S	Pearson Education
2	Wireless Communications	2007.	Andrea Goldsmith	Cambridge University Press

REFERENCES:

1.	Fixed Broadband Wireless System Design	2003.	HARRY R. ANDERSON	John Wiley –India
2.	3G Wireless Networks	2nd Edition, 2007	Clint Smith. P.E., and Daniel Collins	Tata McGraw Hill
3.	Wireless Communication and Networking	2007	Vijay. K. Garg, Morgan Kaufmann	Publishers, http://books.elsevier.com/9780123735805
4.	Principles of Wireless Networks	2006.	Kaveth Pahlavan,. K. Prashanth Krishnamuorthy	Prentice Hall of India,
5.	Wireless Communications and networks	2nd Ed., 2007.	William Stallings	Pearson / Prentice Hall of India,

		June 2018	1.00	Applicable for Sem 1 & 2 AY 2018-19 & Sem 3 & 4 AY 2019-20 Onwards
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II Semester

ET2917	PE II: Selected Topics In Communication Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
This course takes a unified view of the fundamentals of wireless communication and explains the web of concepts underpinning these advances at a level accessible to an audience with a basic background in probability and digital communication. Particular emphasis is placed on the interplay between concepts and their implementation in systems.

UNIT-1:
Physical modeling for wireless channels**:** Free space, fixed transmit and receive antennas, moving antenna , Reflection from wall, Reflection from a ground plane , Power decay with distance and shadowing ,Moving antenna with multiple reflectors Input /output model of the wireless channel: linear time-varying system, Baseband equivalent model, A discrete-time baseband model, Degrees of freedom, Additive white noise Time and frequency coherence **:**Doppler spread and coherence time, Delay spread and coherence bandwidth. Statistical channel models **:**Rayleigh and Rician fading**.**

06Hrs

UNIT-2:
Detection in a Rayleigh fading channel: Non-coherent and Coherent detection Time diversity
Antenna diversity : Receive diversity, Transmit diversity, MIMO. Frequency diversity :Single-carrier with ISI equalization, Direct-sequence spread-spectrum

06 Hrs

UNIT-3
AWGN channel capacity Capacity of Flat: Fading Channels- Channel Distribution Information (CDI), Channel Side Information at Receiver, Channel Side Information at Transmitter and Receiver, Capacity with Receiver Diversity Capacity of Frequency: Selective Fading Channels- Linear time-invariant, Time-Varying Channels

06 Hrs

UNIT-4:
Multiplexing capability of deterministic MIMO channels : Capacity via singular value decomposition, Rank and condition number. Physical modeling of MIMO channels: Line-of-sight SIMO channel ,Line-of-sight MISO channel , Antenna arrays with only a line-of-sight path ,Geographically separated antennas,Line-of-sight plus one reflected path Modeling of MIMO fading channels**.**

06 Hrs

UNIT-5
The V-BLAST architecture Fast fading MIMO channel: Capacity with CSI at receiver and Full CSI. Receiver architectures: Linear decorrelator, Successive cancellation, Linear MMSE receiver D-BLAST**:** an outage-optimal architecture, Coding across transmit antennas: D-BLAST.

06 Hrs

UNIT-6:
Diversity–multiplexing tradeoff: Scalar Rayleigh channel, Parallel Rayleigh channel, MISO Rayleigh channel, 2×2 MIMO Rayleigh channel, nt ×nr MIMO i.i.d. Rayleigh channel Universal code design for optimal diversity: multiplexing tradeoff - Universal code design for scalar channels, parallel channels, MISO channels, MIMO channels Uplink with multiple receive antennas: Space-division multiple access ,SDMA capacity region MIMO uplink:SDMA with multiple transmit antennas, Downlink with multiple transmit antennas MIMO downlink.

06 Hrs

Text books:

1	Fundamentals of Wireless Communications	2005	David Tse, Pramod Viswanath	Cambridge University Press

Reference books:

1	Coding for Wireless Channels	2007	E. Biglieri,	Springer,
2	MIMO Wireless Communications	2007	E. Biglieri,	Cambridge University Press
3	WIRELESS COMMUNICATIONS	2005	Andrea Goldsmith	Cambridge University Press

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II Semester

ET2918	PE II: Speech Processing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES: This course provide with an overview of speech communication in its wide ranging aspects,from a discussion of how humans produce and perceive speech to details of computer based speech processing for diverse communication applications.

UNIT-1: Speech Production
Human speech production mechanism, acoustic theory of speech production, Digital models for speech production.
06Hrs

UNIT-2: TIME DOMAIN MODELS FOR SPEECH PROCESSING
Introduction- Window considerations, Short time energy and average magnitude Short time average zero crossing rate ,Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Pitch period estimation using the autocorrelation function.
06Hrs

UNIT-3: FREQUENCY DOMAIN METHOD FOR SPEECH PROCESSING
Short Time Fourier analysis: Fourier transform and linear filtering interpretations, Sampling rates - Spectrographic displays - Pitch and formant extraction - Analysis by Synthesis - Analysis synthesis systems: Phase vocoder, Channel Vocoder -Homomorphic speech analysis: Cepstral analysis of Speech, Formant and Pitch Estimation, Homomorphic Vocoders.
07Hrs

UNIT-4: LINEAR PREDICTIVE CODING (LPC) ANALYSIS
Basic principles of Linear Predictive Analysis:The Autocorrelation Method, The Covariance Method,Solution of Lpc Equations: Cholesky Decomposition, Solution for Covariance Method, Durbin's Recursive Solution for the AutoCorrelation Equations, Comparision between the Methods of Solution of the LPC Analysis Equations, Applications of LPC Parameters: Pitch Detection using LPC Parameters, Formant Analysis using LPC Parameters.
07Hrs

UNIT-5: Speaker Recognition:
Issues in speaker recognition, Speaker verification vs identification, Text-dependent vs text-independent speaker recognition, Vector quantization models applications in speaker recognition, and Gaussian mixture modeling for speaker and speech recognition
06Hrs

UNIT-6: Discrete and Continuous Hidden Markov modeling for isolated word and continuous speech recognition, DTW.
06Hrs

Text books:

1	Discrete-time speech signal processing: Principles and Practice	2002	T.F Quatieri	Pearson
2	Digital Processing of Speech Signals	1978.	L R Rabiner,	Pearson
3.	Fundamentals of Speech Recognition	1993	L. Rabiner and B. Juang	Pearson

Reference books:

1	Speech Communication – Human and Machine	2000	Douglas O'Shaugnessy	IEEE Press

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II Semester

ET2919	PE II: Detection and Estimation Theory	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
This course provides an introduction to the basic theory and techniques of signal detection and estimation. It provides essential background for engineers and scientists working in a number of fields, including communications, control, signal, and image processing, radar and sonar, radio astronomy, seismology, remote sensing, and instrumentation.

UNIT-1:
Review of Probability Theory; Stochastic Processes; Representation of Stochastic Processes;

06Hrs

UNIT-2:
Classical Detection and Estimation Theory Elementary hypothesis testing, Bayes rule, minimax rule, Neyman-Pearson rule; composite hypothesis testing.

06Hrs

UNIT-3
Detection of deterministic and random signals in Gaussian noise; Detection in non-Gaussian noise; Chernoff bound, asymptotic relative efficiency; sequential and distributed detection;

06Hrs

UNIT-4:
Estimation Theory: estimation of parameters, Random parameters: Bayes Estimates, Estimation of , Nonrandom parameters, Properties of Estimators, LMSE.

06Hrs

UNIT-5
Estimation of Waveforms: Linear MMSE Estimation of waveforms, Estimation of Stationary processes: Wiener filter, Estimation of Non-stationary processes: Kalman filter, Nonlinear estimation

06Hrs

UNIT-6:
Nonparametric detection, Locally optimal detection, Robust detection and estimation.
Applications of detection and estimation Applications in diverse fields such as communications, system identification, adaptive filtering, pattern recognition.

06Hrs

Text books:

1	Introduction to statistical Signal processing with Applications	1989.	Srinath, Rajasekaran&Viswanathan	Prentice Hall of India, New Delhi
2	An Introduction to Signal Detection and Estimation	1994	H.V. Poor	2nd edition, Springer,
3	Fundamentals of Statistical Signal Processing:Vols.1&2	1993, 1998	S.M. Kay	Prentice Hall,

Reference books:

1	Detection, Estimation and Modulation Theory	1968.	. E.L. Van Trees	Wiley, New York,
2	Detection of signals in noise and estimation	1985	Shanmugam and Breipohl	John Wiley & Sons, New York
3	Signal processing: Discrete Spectral analysis, Detection and Estimation	1975	Mischa Schwartz and Leonard Shaw	Mc-Graw Hill Book Company

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II Semester

ET2920	PE II: Real Time Operating Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

Objective

The course objective is to cover the principles of real-time and embedded systems inherent in many hardware platforms and applications being developed for engineering applications. As part of this course, students will learn about real-time and quality of service system principles, understand real-time operating systems and the resource management and quality of service issues that arise, and construct sample applications on representative platforms.

UNIT-1:

Overview Of Commands, File I/O. (Open, Create, Close, Lseek, Read, Write), Process Control (Fork, Vfork, Exit, Wait, Waitpid, Exec), Signals, Inter Process Communication (Pipes, FIFOs, Message Queues, Semaphores, Shared Memory).

06 Hrs

UNIT-2:

Typical Real Time Application, Hard Vs Soft Real Time Systems, a Reference Model of Real Time Systems: Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency.

06 Hrs

UNIT-3

Functional Parameters, Resource Parameters of Jobs and Parameters of Resources Clock Driven, Weighted Round Robin, Priority Driven, Dynamic Vs State Systems, Effective Release Times and Dead Lines, Offline Vs Online Scheduling.

06 Hrs

UNIT-4:

Overview, Time Services and Scheduling Mechanisms, other Basic Operating System Function, Processor Reserves and Resource Kernel. Capabilities of Commercial Real Time Operating Systems.

06 Hrs

UNIT-5

Introduction, Fault Causes, Types, Detection, Fault and Error Containment, Redundancy: Hardware, Software, Time. Integrated Failure Handling.

06 Hrs

UNIT-6:

Memory Managements Task State Transition Diagram, Pre-Emptive Priority, Scheduling, Context Switches – Semaphore – Binary Mutex, Counting: Watch Dogs, I/O System Process Management, Scheduling, Interrupt Management, and Synchronization.

06 Hrs

Text books:

1	Real Time Systems	1999	Jane W.S. Liu	Pearson
2	Real Time Systems		C.M.Krishna, KANG G. Shin	McGraw.Hill

Reference books:

1	Advanced Unix Programming	Richard Stevens

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II Semester

ET2921	Seminar	L=0	T=0	P=2	Credits=1

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
			100		100	

III Semester

ET2931	PE III: Multimedia Communications			L= 3	T = 0	P = 0	Credits = 3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE		Total	ESE Duration
	15	15	10	60		100	3 Hrs

Course Objectives

1. To learn the basics of image & graphics data types
2. To understand various Fundamental concepts in video
3. To grasp basics of digital audio
4. To get acquainted with various algorithms used for multimedia data compression
5. To explore various standards used in image, video and audio compression

UNIT-1: Introduction to multimedia , concept of non-temporal and temporal media, Graphics & image data representation: graphics & image data types, computer image processing: Image synthesis, analysis and transmission, popular file formats(GIF, TIFF, JPEG, PNG**)**

06 Hrs

UNIT-2: Fundamental concepts in video Types of video signals: component, composite and s-video,
analog video :NTSC, PAL, SECAM video, digital video : chroma sub-sampling, CCIR standards for digital video, HDTV,

06 Hrs

UNIT-3: Basics of digital audio:
digitization of sound, MIDI, quantization and transmission of audio

06 Hrs

UNIT-4:
Multimedia data compression
Lossless compression algorithms: Run length coding, Huffman coding, arithmetic coding
Lossy compression algorithms - DCT, Wavelet- Based Coding
Basic image compression standard- JPEG- **main steps in JPEG Image compression, Image preparation, JPEG modes- Lossy sequential DCT based, Expanded lossy DCT based, Lossless and hierarchical mode**

06 Hrs

UNIT-5: Video compression
Introdction to video compression, video compression based on motion compensation, search for motion vectors, detail study of various video compression standards-MPEG-1, MPEG-2, MPEG-4, MPEG-7

06 Hrs

UNIT-6: Audio compression
Basic audio compression techniques, , MPEG audio compression, Applications of multimedia related to image and video processing

06 Hrs

Text books:

1	Fundamentals of Multimedia	2004	Ze-Nian Li , Mark S Drew	PHI/Pearson Education
2	Multimedia Applications	2004	Steinmetz, Nahrst	Springer

Reference books:

1	Multimedia Communications: Applications, Networks, Protocols and Standars	2001	Fred Halsall	Addison-Wesley

Course Outcome:
Students will be able to

1.Graphics/image/video/audio data representations, including color models, HDTV, MIDI, and audio coding
2.Compression formats and standards for data, images, audio, and video, including both lossless and lossy formats
3.Multimedia networks, considering QoS, VoIP, media-on-demand, and multimedia over wireless networks
4.Content-based retrieval in digital libraries

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III Semester

ET2932	PE III: Active RF Devices and Circuits	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
Analyze microwave components and circuits in terms of scattering parameters. Determine the electrical characteristics of waveguides and transmission lines through electromagnetic field analysis. Design microwave amplifiers and oscillators based on stability, bandwidth, power, gain and noise figure criteria.

Unit 1
Active RF Component & their Modeling: RF Diodes, Linear & Non linear Diode Models, small & large signal Model of BJT & FET, Active Device Measurements

06 Hrs

UNIT 2
Transistor Amplifiers - Types of amplifiers. S parameter characterization of transistors; Two Port power gain Amplifier Stability , Stability Circle , Test for Unconditional Stability, MOSFETs , Equivalent circuit model.

06 Hrs

UNIT-3:
Single stage amplifier design- unilateral and bilateral cases, Design for Maximum Gain Constant gain, design for Specified Gain , DC bias circuits for amplifiers;

06 Hrs

UNIT-4
Detectors - Point contact and Schottky barrier diodes. Characteristics and equivalent circuit, Theory of microwave detection, Detector circuit design, FM detectors. Low Noise amplifier and Power amplifier : Class A, B, AB, C, D, E, F

06 Hrs

UNIT-5:
Types of mixers. Mixer theory and characteristics. SSB versus DSB mixers. Single-ended mixer and single-balanced mixer. Double balanced and image rejection mixers;

06 Hrs

UNIT-6
Oscillators Oscillator versus amplifier design, Oscillation conditions; Gunn diode Modes of operation, Equivalent circuit. Design of Gunn diode oscillator, FET oscillators. Frequency tuning techniques. Phase Locked Loop (PLL).

06 Hrs

Text books:

1	Radio Frequency and Microwave Communication Circuits Analysis and Design	2004	D. K. Misra	John Wiley,
2	Microwave Engineering	1998	D. M. Pozar	John Wiley
3.	**RF Circuits Design**		Renhold Ludwig and Pavel Bretchko	Prentice Hall

Reference books:

1	Microwave Transistor Amplifiers Analysis and Design	1997.	G. Gonzalez	Prentice Hall
2	The Design of CMOS Radio-Frequency Integrated Circuits	Second Edition	Thomas H. Lee	CAMBRIDGE
3	Microwave and Millimeter Wave Phase Shifters, Vol.II- Semiconductor And Delay Line Phase Shifters,	1991	S.K. Koul and B. Bhat	Artech House
4	Microwave Circuit Design using Linear and Nonlinear Techniques,	1990	G.D. Vendelin, A.M. Pavio and U.L. Rhode	

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III Semester

ET2933	PE III: Soft Computing	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

Objective The objective is to have general understanding of soft computing methodologies including artificial neural networks, genetic algorithms, fuzzy sets and fuzzy logic systems. Develop computational neural network models and fuzzy models for engineering systems.

Unit 1
Genetic algorithms: Population based search techniques, evolutionary strategies, mathematical foundations of genetic algorithms, search operators, genetic algorithms in function and combinational optimization, hybrid algorithms, application to pattern recognition

06 Hrs

Unit 2
Introduction of neural networks, NN Architecture Neural learning and laws, Applications of ANN Evaluation of network,
Supervised Learning:
Single layer network: MP neuron, Perceptron, Perceptron training algorithm, LMS algorithm, ADALINE

06 Hrs

Unit 3
Multiplayer network: Multilevel Discrimination, Backpropogation Algorithm, Setting the parameter values, Accelerating the learning Process, MADALINE, Adaptive Multilayer Networks, Recurrent Network, RBF networks,

06 Hrs

Unit 4
Unsupervised Learning: Winner Take Network, Learning Vector Quantizer, ART Networks, self-organizing feature maps, PCA, Associate Models

06 Hrs

Unit 5
Overview of Crisp Sets, Concepts of Fuzzy sets, representation of fuzzy sets, extension principle, fuzzy compliments, t-norms and t- conorms Fuzzy numbers, arithmetic operation on intervals and on fuzzy sets, lattice of fuzzy numbers

06 Hrs

Unit 6
Fuzzy equations, fuzzy relations , Fuzzy controllers, Defuzzification Methods, Fuzzy Inference Techniques, applications of fuzzy logic

06 Hrs

Text books:

1	Neural networks	2004	C. Mohan and S. Ranka	Penram publications
2	Fuzzy sets and fuzzy logic, Theory and Applications ,	2009	George J. Klir, Bo Yuan	PHI
3	Neural Networks: A comprehensive foundation	1999	S. Haykin	Pearson

Reference books:

1	Introduction to artificial neural networks	1997	J. M. Zurada	Jaico publishing
2	Artificial Neural Networks	1999	B. Yejnanarayana	PHI
3	Neural Networks, Fuzzy Logic, and Genetic algorithms, Synthesis and Applications	2006	S.Rajasekaran, G.A.Viayalakshmi Pai	Prentice Hall

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III Semester

ET2934	PE IV: High Speed Networks		L=3	T=0	P=0	Credits=3
Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
The main purpose of this course is to introduce students the important areas of communication networks, mainly Multistage networks .This will enable the students to acquire a solid understanding of foundations of networks technologies, systems, networks issues as well as economic deployment considerations, of networks technologies, systems, networks issues as well as economic deployment considerations.

UNIT-1:
Network services, Network Elements, Basic Network Mechanism, High Performance Networks, Traffic Characterization and quality of service, Applications, Layered Architecture.

06 Hrs

UNIT-2:
OSI and IP Models, Frame Relay, Internet Protocol, TCP and UDP, Performance of TCP/IP networks, Internet Success and Limitation

06 Hrs

UNIT-3 :
Wireless Networks: Introduction, The wireless Channel, Link Level Design, Channel Access, Network Design

06 Hrs

UNIT-4:
Control of Networks: Objectives and Methods of Control, Circuit-switched Networks, Datagram Networks, Mathematical Background of Control Networks.

06 Hrs

UNIT-5:
Introduction to Adhoc Wireless Networks, Issues, Routing approaches, Table-Driven of Routing Protocols, On-Demand Routing Protocols, Hierarchical routing Protocols. Ad hoc network security- Requirements, Issues and Challenges

06 Hrs

UNIT-6:
SONET, Optical Links, WDM Systems, Optical Cross-Connects, Optical LANs, Optical Paths and Networks

06 Hrs

Text books:

1	Computer Networking	2005	J.F.Kurose & K.W. Ross	Pearson
2	High-Performance Communication Networks	2e	Jean Warland Pravin Varaiya	Elsevier

Reference books:

1	Adhoc Wireless Networks	2005	C.Siva Ram Murthy & B.S.Manoj	Pearson Education, 2005.

III Semester

ET2935	PE IV: Wireless Sensor Network	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
To expose the students the fundamental concepts of IP based wireless communication systems/networks. To impart students with Wireless/Mobile IP Architecture and Evolution; Performance and Quality of Service; Mobility, Routing, and Signaling; Real-Time Applications.

UNIT-1:
Introduction to sensors**-** Definition of sensor & its difference from transducer, Classification of sensors, application of sensors in various fields. Architecture-single node architecture-hardware components, energy consumption of sensor nodes, operating system and execution **environments**

06Hrs

UNIT-2:
Network architecture-optimization goal and figure of merit-design principles for WSN, service interface of WSN, Gateway concept challenges of WSN, comparison with other network.

06Hrs

UNIT-3
Wireless channel and communication fundamental, physical layer and transceiver design consideration in WSN.

06Hrs

UNIT-4:
MAC Protocols-Fundamental of MAC Protocol, low duty cycle protocol and wakeup concepts, schedule based protocols , Link layer protocols, routing protocols ,

06Hrs

UNIT-5
Naming and addressing, Time synchronization, Properties of Localization and positioning procedures, single hop localization, positioning in multihop environments, and impact of anchor placement.

06Hrs

UNIT-6:
Data centric routing, Data aggregation, Data centric storage, Topology control-controlling topology in a flat network, Hirarical network by dominating set, Hierarchical network by clustering, combining Hierarchical topologies and power control**.**

06Hrs

Text books:

1	Protocols and architecture for Wireless Sensor Networks	2007	Holger Karl, Andreas Willig,	Wiley
2	Handbook of Algorithms for Wireless Networking and Mobile Computing	2006	AzzedineBoukerche	Chapman & Hall/CRC, 2006

Reference books:

1	Wireless Sensor Network Designs,	2003	Anna Hac	Wiley
2	Wireless Sensor Networks : A systems perspective	2005	NirupamaBulusu and Sanjay Jha	Artech House, August 2005.
3	Wireless Sensor Networks : Architecture and Protocols	2003	Jr., Edgar H. Callaway,	Auerbach, 2003.
4	Wireless Sensor Networks	2005	C.S. Raghavendra, Krishna M. Sivalingam and TaiebZnati	Springer,

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III Semester

ET2936	PE IV: Micro Electro Mechanical Systems	L=3	T=0	P=0	Credits=3

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
	15	15	10	60	100	3 hrs

OBJECTIVES:
To give detail study of micro electronics circuit and various devices in the manufacturing process of MEMS.
To give brief introduction regarding various processes involved in the manufacturing of MEMS.

UNIT-1:
Intrinsic Characteristic of MEMS :- Energy Domains & Transducers. Sensors & Actuators. Introduction to Micro fabrication- silicon based MEMS processes. New Materials- Review of Electrical and Mechanical concepts in MEMS. Semiconductor devices- Stress & Strain analysis- Flexural beam bending, Torsional deflection

07Hrs

UNIT-2:
Electrostatic sensors- Parallel Plate capacitors, Applications, Interdigital Finger capacitor,Com drive devices, Thermal sensing and Actuation, Thermal Expansion, Thermal couples, Thermal resistors, Applications, Magnetic Actuators, Micro magnetic Components, Case studies of MEMS in magnetic actuators

06Hrs

UNIT-3
Piezoresistive sensors, Piezoresistive sensor materials, Stress analysis of mechanical elements, Applications to Inertia, Pressure, Acoustic, Tactile and Flow sensors, Piezoelectric sensors and actuators, Piezoelectric effects, Piezoelectric materials.

06Hrs

UNIT-4:
Silicon Anisotropic Wet Etching, Dry Etching of Silicon, Plasma Etching, Deep reaction Ion Etching (DRIE), Isotropic Wet Etching, Gas phase Etchants-Case studies, Basic surface micromachining processes, Structural and sacrificial materials, Acceleration of sacrificial Etch, Striction and Anistriction methods, Assembly of 3D MEMS,Foundry process

08Hrs

UNIT-5
Polymers in MEMS , Polimide, SU-8, Liquid Crystal Polymer(LCP), PDMS, PMMA, Parylene,Flurocarbon, Application to acceleration, Pressure, Flow and Tactile sensors

06Hrs

UNIT-6:
Optical MEMS, Lensens and Mirrors, Actuators for Active Optical MEMS.

06Hrs

Text books:

1	Foundations of MEMS	2006	Chang Liu,	Pearson Education Inc

Reference books:

1	An Introduction to Micro electro mechanical system design	2000	Nadim Maluf	Artech House
2	The MEMS Handbook	2000	Mohames Gad-el-Hak	CRDC press Baco Raton
3	MEMS & Micro systems Design and Manufacture	2002	Tai Ran Hsu,	Tata Mcgraw Hill, New Delhi.

III Semester

ET2937	PROJECT PHASE - I	L=0	T=0	P=16	Credits=8

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
			100		100	

OBJECTIVES

As the project methodology for the batches is decided in the 2nd semester the student shall carry out the project work further 3rd semester. The project work consists of ;

1. Literature survey
2. Study of processes /phenomenon related to project.
3. Design of any equipment its fabrication and testing.

IV Semester

ET2940	PROJECT PHASE – II	L=0	T=0	P=24	Credits=12

Evaluation Scheme	MSE-I	MSE-II	TA	ESE	Total	ESE Duration
			40	60	100	

1. Review of work done in project phase I and final Design of any equipment, its fabrication and testing.
2. Critical analysis of design or process for optimization
3. Verification by experimentation.
4. In case of industrial project the necessary modifications with the proper design suggested to the industry should be explained. The letter from the industry should be attached in the report related to the performance of the student.