Course Structure & Curriculum

for

M. Tech. Programme

in

Electronics Engineering

with specialization in

Communication Systems

Department of Electronics and Communication Engineering

Motilal Nehru National Institute of Technology Allahabad

Allahabad - 211004, Uttar Pradesh

MOTILAL NEHRU NATIONAL INSTITUTE OF TECHNOLOGY ALLAHABAD

VISION

To establish a unique identity for the Institute amongst National and International Academic and Research Organizations through knowledge creation, acquisition and dissemination for the benefit of Society and Humanity.

MISSION

To generate high quality human and knowledge resources in our core areas of competence and in emerging areas to make valuable contribution in technology for social and economic development of the Nation and to make organized efforts for identification, monitoring and control of objective attributes of quality for continuous enhancement of academic processes, infrastructure and ambiance.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

VISION

To become a globally leading department of higher learning, building upon the culture, the values of universal science and contemporary education, and a center of research and education generating the knowledge and the technologies which lay the groundwork in shaping the future in the fields of Electronics and Communication Engineering.

MISSION

To provide quality education and research leading to B. Tech., M. Tech. and Ph. D. degree in the area of Electronics and Communication Engineering and Technology which may produce globally acceptable high quality skilled manpower.

To impart technical education which may provide innovative skills in their respective area of specialization for society in general with universal moral values, adherent to the professional ethical codes.

To generate and disseminate knowledge and technologies essential to the local and global needs in the field of Electronics and Communication Engineering.

M. Tech. (Electronics Engineering) with specialization in Communication Systems

Proposed Course Structure & Scheme of Evaluation

I Semester

Subject Code	Subject Name	L	T	P	Credits				Total Marks
						TA	MSE	ESE	
EC21103	Principles of Communication Systems	3	1	0	4	20	20	60	**100**
EC21104	Wireless and Mobile Communication	3	1	0	4	20	20	60	**100**
EC213xx	Elective I	3	1	0	4	20	20	60	**100**
EC213xx	Elective II	3	1	0	4	20	20	60	**100**
EC212xx	Elective III	0	0	6	4	50	-	50	**100**

Total Credits = 20

II Semester

Subject Code	Subject Name	L	T	P	Credits				Total Marks
						TA	MSE	ESE	
EC22103	Advanced optical Communication	3	1	0	4	20	20	60	**100**
EC22104	Communication Networks	3	1	0	4	20	20	60	**100**
EC223xx	Elective IV	3	1	0	4	20	20	60	**100**
EC223xx	Elective V	3	1	0	4	20	20	60	**100**
EC222xx	Elective VI	0	0	6	4	50	-	50	**100**

Total Credits = 20

III Semester

Subject Code	Subject Name	Credits	Eval (100)
EC23601	Thesis	16	Marks
EC23651	Special Study/Industrial Training/Colloquium	4	Marks

Total Credits = 20

IV Semester

Subject Code	Subject Name	Credits	Eval (100)
EC24601	Thesis	20	Marks

Total Credits = 20

Note: The distribution of thesis evaluation marks will be as follows:

1. Supervisor(s) evaluation component 60%
2. Oral Board evaluation component 40%

List of Professional Electives for Communication Systems

Elective I (EC213xx)

1. EC21321 DSP for Communication
2. EC21322 RF and Microwave Communication
3. EC21323 Optimization Techniques
4. EC21324 Linear Algebra

Elective II (EC213xx)

1. EC21325 Random Theory, Stochastic Process and Queueing Theory
2. EC21326 Communication System Design
3. EC21327 Information Theory and Coding
4. EC21328 VLSI for Communication

Elective III (EC212xx)

1. EC21211 Communication System Design Lab
2. EC21212 Optical Communication Lab
3. EC21213 RF and Microwave Lab

Elective IV (EC223xx)

1. EC22321 Radar and Satellite Communication
2. EC22322 Image Processing and Pattern Recognition
3. EC22323 Wireless Sensor Networks
4. EC22324 Advance Signal and Image Processing

Elective V (EC223xx)

1. EC22325 Detection and Estimation Theory
2. EC22326 Antenna Design and MIMO Systems
3. EC22306 Embedded Systems
4. EC22328 Artificial Intelligence and Machine Learning

Elective VI (EC222xx)

1. EC22211 Data Communication Networks Lab
2. EC22212 Advance Communication Lab
3. EC22213 Advanced Digital Signal and Image Processing Lab

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	To excel in professional career and/or higher education by acquiring knowledge in area of Communication Systems
PEO 2	To analyze real time problems, design appropriate system to provide solutions that are technically sound, economically feasible and socially acceptable
PEO 3	To exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning

Mapping of Mission statements with the PEOs

Key components from Department Mission	**PEO 1**	**PEO 2**	**PEO 3**
• To provide quality education and research leading to B. Tech., M. Tech. and Ph. D. degree in the area of Electronics and Communication Engineering and Technology which may produce globally acceptable high quality skilled technical manpower • To impart technical education which may provide innovative skills in their respective area of specialization for society in general with universal moral values, adherent to the professional ethical codes • To generate and disseminate knowledge and technologies essential to the local and global needs in the field of Electronics and Communication Engineering			
Quality education	YES		
Professional career	YES	YES	YES
Higher education	YES	YES	
Social responsibility			YES
Research		YES	

EC21103 Principles of Communication Systems **FIRST SEMESTER**

Review of communication systems.

Digital transmission through band-limited channels, signal design for band-limited channels, binary, duo-binary and M-ary signal systems. Probability of error calculations, symbol synchronization, equalization, linear equalization, decision feedback equalization, adaptive equalization. Digital carrier modulation scheme, probability of error calculations for various signalling schemes, QAM, continuous phase frequency shift keying (CPFSK), MSK.

Digital transmission on fading multipath channels, coding for reliable digital transmission systems, coding for BW constrained channels, diversity for fading multipath channels, RAKE receiver.

Model of spread spectrum communication systems, DSSS and FHSS, other types of spread spectrum signals. multi-channel and multi-carrier systems in AWGN channels, binary signals, M-Array orthogonal signals.

MATLAB simulation of communication systems.

References:

1. B. P. Lathi, *Modern Digital and Analog Communications Systems*, The Oxford Series in Electrical and Computer Engineering, Third Edition
2. D. R. Smith, *Digital Telecommunication*", Springer
3. Simon Haykin, *Communication Systems*, John Wiley & Sons, Inc. 4th Edition
4. John G. Proakis, *Digital communications*, McGraw Hill Education (India) Private Limited, Fifth edition
5. K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley India Pvt. Ltd
6. William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, *Principles of communication Systems Simulations,* Prentice Hall Communications Engineering and Emerging Techno
7. B. Sklar, *Digital communication: Fundamentals and applications*, Prentice Hall

EC21104 Wireless and Mobile Communication

Review of Cellular Concepts.

Radio Wave Propagation: Small scale fading and multipath: small scale multipath propagation, impulse response model of a mulitpath channel, small scale multipath measurements, parameters of mobile multipath channels, types of small scale fading.

Capacity of Wireless Channel: Capacity of flat fading channel, channel distribution information known, channel side information at receiver, channel side information at transmitter and receiver, capacity with receiver diversity, capacity comparisons, capacity of frequency selective fading channels.

Performance of digital modulation over wireless channels:

Diversity: Realization of independent fading paths, receiver diversity, selection combining, threshold combining, maximal-ratio combining, equal-gain combining, transmitter diversity, channel known at transmitter, channel unknown at transmitter, the Alamouti scheme-basic concepts of RAKE receivers.

Multiple Access Techniques: Frequency division multiple access, time division multiple access, spread spectrum multiples access, space division multiple access, packet ratio.

MIMO and multicarrier modulation: Narrowband MIMO model, parallel decomposition of MIMO Channel, MIMO channel capacity, MIMO diversity gain, data transmission using multiple carrier’s multi carrier modulation with overlapping sub channels, mitigation of subcarrier fading, basic concepts of OFDM.

References:

1. Andrea Goldsmith, *Wireless Communications*, Cambridge University Press, 2005
2. T. S. Rappaport, *Wireless Communications*, Pearson Education, 2003
3. Raj Pandya, *Mobile and Personal Communication Systems and Services*, Prentice Hall of India, 2002
4. William C. Y. Lee, *Wireless and Cellular Telecommunications*,” Third edition, Mc. Graw Hill, 2006

EC22103 Advanced Optical Communication **SECOND SEMESTER**

Introduction to Fiber Communication System: Review of basic principles of light propagation, Optical fibers - modal propagation, signal distortion on optical fibers. Source & Detectors: Design of LED's for optical communication, semiconductor Lasers for optical fiber communication system, semiconductor Photodiode detectors, Avalanche Photodiode detectors & Photo multiplier tubes, Photo receivers, Noise sources.

Modulation schemes: Channel impairments, and optical transmission system design principles, Advanced modulation formats, OFDM, polarization multiplexing, constrained coding, and coherent detection: - Multilevel modulation schemes - Orthogonal frequencydivision multiplexing (OFDM) - Polarization multiplexing - Constrained (line or modulation) coding, and Coherent detection.

Error Correction Techniques: Forward error correction (FEC)-Linear block codes and cyclic codes, BCH and RS codes, Concatenated codes, Turbo- and turbo-product codes, and LDPC codes. Coded modulation schemes: Multilevel coding. Bit-interleaved coded modulation, and Coded OFDM.

Advanced chromatic dispersion compensation, Signal pre-distortion compensation, Postdetection compensation: feed-forward equalizer (FFE), decision feedback equalizer (DFE), maximum likelihood sequence estimation (MLSE) or Viterbi equalizer (VE), turbo equalization (TE), Compensation of chromatic dispersion by OFDM, Advanced PMD compensation: Optical compensation techniques, Electrical compensation techniques

References:

1. Senior, *Optical Fibre Communication*, PHI – 2nd Edition
2. B. Djordjevic, W. Ryan and B. Vasic, *Coding for Optical Channels,* Springer, 2010
3. Gerd Keiser, *Optical Fibre Communication*, Mc. Graw Hill – 2nd Edition
4. M. Cvijetic, I. B. Djordjevic, *Advanced Optical Communication Systems and Networks*. Artech House, Jan. 2013

EC22104 Communication Networks **SECOND SEMESTER**

Introduction to Communication Networks: Introduction, Evolution of Communication Networks, Challenges in Communication Networks, Overview of various Communication

Networks, Wireless Communications Principles and Fundamentals, Different Generations of Cellular Systems, Future Trends: 5G Systems and Beyond.

Wireless LANs, PANs and MANs: Introduction, Fundamentals of WLAN - Technical Issues, Network Architecture, WLAN Topologies, IEEE 802.11 Physical Layer, The Medium Access Control (MAC) Layer, Latest Developments and varients if IEEE802.11, Bluetooth - Specification, Transport Layer, Middleware Protocol Group, Bluetooth Profiles, IEEE 802.16 - Differences between IEEE 802.11 and 802.16 PHY and MAC.

Wireless Internet: Introduction –wireless internet, address mobility, inefficiency of transport layer and application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, IP level Mobility Management for Wireless Networks

TCP in wireless domain – TCP over wireless, TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

Ad Hoc Wireless Networks and Wireless Sensor Networks: Introduction, issues –medium access scheme, routing, multicasting, transport layer protocol, pricing scheme, QoS provisioning, self-organization, security, addressing, service discovery, energy management, deployment consideration, ad-hoc wireless internet.

WSN: issues and design challenges, architecture – layered and clustered , data dissemination, data gathering, Mac protocols, location discovery, quality of sensor network – coverage and exposure, zigbee standard.

References:

1. Aftab Ahmad, *Wireless and Mobile Data Networks*, John Wiley & Sons, Ltd. 2005. 2. P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis, *Wireless Networks*, John Wiley & Sons, Ltd. 2003.
3. C. Siva Ram Murthy and B.S. Manoj, *Ad-hoc Wireless Networks - Architecture and Protocols*, Pearson Education, 2005.
4. Kaveh Pahlavan and Prashant Krishnamurthy, *Principle of Wireless Networks - A Unified Approach*, Prentice Hall, 2006.
5. Jochen Schiller, *Mobile Communications*, Pearson Education, 2005.
6. Wllliam Stallings, *Wireless Communication and Networks*, Prentice Hall, 2005.
7. T. S. Rappaport, *Wireless Communications: Principles and Practice*, Prentice Hall, 2004.

8. Research Papers from Journals (provided by the course instructor)

EC21321 DSP for Communication **FIRST SEMESTER (E-I)**

Fundamentals of Digital Signal Processing: Review of signals and systems, DTFT and Z-Transform.

Discrete Fourier Transform (DFT): Sampling in frequency domain, DFT: properties of the DFT, computational aspect of DFT, circular and linear convolution using DFT, filtering of long data sequence.

FFT Algorithm: Decimation-in-time radix-2 FFT algorithm, decimation-in-frequency radix2 FFT algorithm, Goertzel algorithm.

Digital Filters and Finite Wordlength Effects: Basic structure of IIR and FIR systems, specifications of filters, pipelining and parallel processing of FIR filters, state variable representation of digital filter. Finite wordlength effects: parasitic oscillations, scaling of signal levels, round-off noise, measuring round-off noise, coefficient sensitivity, sensitivity and noise, effect of round off noise in digital filters.

Filter Design Techniques: Digital and analog filtering, filter specifications, magnitude and phase responses, IIR and FIR filters, design of IIR filter, impulse - invariant transformation, Bilinear Z-transform, design of FIR filters using impulse response truncation, FIR filter design using windows, effect of windowing, rectangular, Bartlett, Hanning, Hamming, Blackmann and Kaiser windows.

Multirate Digital Signal Processing: Fundamentals of multirate signal processing, sampling rate conversion, interpolation, decimation, noble identities, polyphase representations, filter banks and perfect reconstruction systems, multirate system advantages and applications.

Digital Signal Processors – Architectures, Implementations and Applications: Introduction, digital signal processors architectures, the TMS320 family, selection of processors, software developments, system considerations, implementation considerations, data representations and arithmetic, finite wordlength effects, programming issues, hardware interfacing, fixed-point and floating-point implementations.

Applications in Telecommunications: Digital compression of speech signals, speech modeling, predictive coding, adaptive predictive coding, adaptive quantizers, adaptive differential pulse code modulation, linear predictive coding of speech signals, echo suppressors, echo cancellers ***References:***

1. J. G. Proakis and D.G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications*, Pearson Education
2. A. V. Oppenheim, *Applications of Digital Signal Processing*
3. A. V. Oppenheim, A. S Willsky, and S. H. Nawab, *Signals and Systems*, Prentice-Hall, Englewood Clieffs
4. K. K. Parhi, *VLSI Digital Signal Processing Systems- Design and Implementation*, John Wiley & Sons
5. Sanjit K. Mitra, *Digital Signal Processing: A Computer based approach*, McGraw Hill, 1998
6. Sen M. Kuo and Woon-Seng Gan, *Digital Signal Processors, architectures, implementations and applications,* Prentice-Hall
7. V. Madisetti, *The Digital Signal Processing Handbook*, IEEE press, ISBN 0849385725
8. R. E. Crochiere and L. R. Rabiner, *Multirate Digital Signal Processing*, PrenticeHall, 1983

EC21322 RF and Microwave Communication **FIRST SEMESTER (E-I)**

Introduction to RF and Microwave Engineering: RF and Microwave Engineering, Communication over Distance, Review of Electromagnetic Theory, Radio Architecture, Conventional Wireless Communications, RF Power Calculations, Receiver, Transmitter, and Transceiver at RF Systems, RF Signals, Analog Modulation, Digital Modulation, Interference and Distortion, Early Receiver Technology, Modern Transmitter Architectures, Modern Receiver Architectures.

Transmission Medium & Antenna: Analysis of Transmission Line, Wave Propagation on a Transmission Line, The lossless &lossy Transmission Line, Smith Chart, Coaxial Line, General Solutions for TEM, TE, and TM waves Rectangular Waveguide and Circular Waveguide, Strip &Microstrip Line, Fundamental Antenna Parameters, Radiation from a Current Filament, RF Antennas, Resonant Antennas, Traveling-Wave Antennas, RF Link, Radio Link Interference.

Microwave Network Analysis: Two-Port Networks, Scattering Parameters, The N-Port Network, Scattering Parameter Matrices of Common Two-Ports, Impedance and Equivalent Voltages, Impedance and Admittance Matrices, Scattering Matrix, Transmission (ABCD) Matrix, Signal Flow Graphs, Discontinuities and Modal Analysis, Excitation of Waveguides.

Design and analysis of microwave filters: Periodic Structures, Filter Design by the Image Parameter, Filter Design by the Insertion Loss, Filter Transformations, Filter Implementation, Stepped-Impedance Low-Pass, Filters Coupled Line Filters, Filters Using Coupled Resonators.

Active Devices for Microwave Circuits: Diodes and Diode Circuits, Microwave Tubes, Microwave Oscillators, Amplifiers, RF and Microwave System Design.

References:

1. David Pozar, *Microwave Engineering*, 2nd ed. Wiley 2004
2. Michael Steer, *Microwave and RF Design: A Systems Approach (Electromagnetic Waves)*, Institution Engineering & Tech.
3. Jordan Bellman, *Electromagnetic Waves and Radiating System*
4. K. C. Gupta, *Microwave*
3. Herbert J. Reich, *Microwave principles*
4. D.C. Agrawal, *Microwave techniques*
5. R. Chatterjee, *Elements of Microwave Engg.*
6. Liao, *Microwave Devices and Circuits*

EC21323 Optimization Techniques **FIRST SEMESTER (E-I)**

Introduction and Basic Concepts: Historical development, Engineering applications of optimization, art of modelling, Objective function, constraints and constraint surface; formulation of design problems as mathematical programming problems, classification of optimization problems, Optimization techniques – classical and advanced techniques.

Optimization using Calculus: Stationary points, functions of single and two variables; Global optimum convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables, Gradient vectors, Examples, Optimization of function of multiple variables subject to equality constraints, Lagrangian function, Optimization of function of multiple variables subject to equality constraints, Hessian matrix formulation, eigen values, Kuhn-Tucker Conditions, Examples.

Linear Programming: Standard form of linear programming (LP) problem, Canonical form of LP problem, assumptions in LP Models, elementary operations, graphical method for two variable optimization problem, Examples, motivation of simplex method, simplex algorithm and construction of simplex tableau, simplex criterion, minimization versus maximization problems, revised simplex method; duality in LP, primal-dual relations, dual simplex method, sensitivity or post optimality analysis, other algorithms for solving LP problems – Karmarkar's projective scaling method.

Linear Programming Applications: Use of software for solving linear optimization problems using graphical and simplex methods, Examples for transportation, assignment, water resources, structural and other optimization problems.

Dynamic Programming: Sequential optimization, representation of multistage decision process, types of multistage decision problems, concept of sub optimization and the principle of optimality, recursive equations – forward and backward recursions, computational procedure in dynamic programming (DP). Dynamic Programming Applications: Discrete versus continuous dynamic programming, multiple state variables; curse of dimensionality in DP.

Dynamic Programming Applications: Problem formulation and application in design of continuous beam and optimal geometric layout of a truss.

Integer Programming: Integer linear programming, concept of cutting plane method. Mixed integer programming, solution algorithms, Examples.

Advanced Topics in Optimization: Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods, Multi level optimization, Direct and indirect search methods. Evolutionary algorithms for optimization and search.

References:

1. S. S. Rao, *Engineering Optimization: Theory and Practice*, New Age International P Ltd., 2000.
2. G. Hadley, *Linear programming*, Narosa Publishing House, New Delhi, 1990.
3. H. A. Taha, *Operations Research: An Introduction*, 5th Edition, Macmillan, New York, 1992.
4. K. Deb, *Optimization for Engineering Design-Algorithms and Examples*, PrenticeHall of India Pvt. Ltd., 1995.
5. K. Srinivasa Raju and D. Nagesh Kumar, *Multicriterion Analysis in Engineering and Management*, PHI Learning Pvt. Ltd.

EC21324 Linear Algebra **FIRST SEMESTER (E-I)**

Algebraic Structures: Sets, functions, Group, homomorphism of groups, Ring, Field, Vector Space, Subspaces, direct sum, metric space, inner product space, Lp space, Banach Space, Hilbert Space. Linear independence, basis, dimension, orthonormal basis, finite dimensional vector spaces, isomorphic vector spaces, Examples of finite and infinite dimensional vector spaces, R^N, C^N .

Linear Transformations: Linear Transformations, four fundamental subspaces of linear transformation, inverse transformation, rank nullity theorem, Matrix representation of linear transformation, square matrices, unitary matrices, Inverse of a square matrix, Change of basis, coordinate transformation, system of liner equations, existence and uniqueness of solutions, projection, least square solution, pseudo inverse.

Matrix Methods and Transforms: Eigen values, Eigen vectors, Generalized Eigen vectors, Diagonalizability, orthogonal diagonalization, Symmetric, Hermitian and Unitary matrices (transformations), Jordan canonical form, Fourier basis, DFT as a linear transformation, Translation invariant linear transformation, wavelet basis, wavelet transforms.

References:

1. G. F. Simmons, *Topology and Modern Analysis*, McGraw Hill
2. Frazier, Michael W. *An Introduction to Wavelets through Linear Algebra*, Springer Publications.
3. Hoffman Kenneth and Kunze Ray, *Linear Algebra*, Prentice Hall of India.

EC21325 Random Theory, Stochastic Process and Queueing Theory

FIRST SEMESTER (E-II)

Introduction to statistical communication theory, Simple binary hypothesis tests: Bayes criteria and Neyman-Pearson tests, receiver operating characteristic and M hypotheses, Classical estimation theory: Bayes estimation, maximum likelihood estimation, Cramer- Rao Inequality and multiple parameter estimation.

Representation of random processes: introduction to random variables, sequence of random variables, central limit theorem, transformation of random variables, characterization of random processes.

Gaussian processes and their properties, Wiener process, White noise processes, optimum linear filters, periodic random processes and vector random process. Detection of signals and estimation of signal parameters in white noise.

Matched filters, correlation receivers, linear and nonlinear estimations, nonwhite Gaussian noise, detections and estimations in nonwhite noise estimation of signals with random amplitude and phase, Rayleigh channels, Rician channels, multiple channels.

Queueing theory, Queueing models, Kendall's notation, The M/M/1 Queueing system, Little law, M/M/1/N Queueing systems, The M/G/1, Queueing systems, Network of queues. Discrete time Queueing systems, Queueing on space division packet switch, Queueing on single-buffered Banyan network.

References:

1. A. Papoulis & S. U. Pillai, *Probability, Random variables and stochastic processes,* 4th Edition, McGraw Hill
2. K. Sam Shanmugan & A. M. Breipohi, *Random Signals,* 2nd Edition, Wiley
3. John J. Proakis, *Digital communication*, Fourth Ed., MGH
4. Thomas G. Robertazzi, *Computer networks and systems: Queueing Theory and Performance Evaluation,* 3rd Edition, Springer.

EC21326 Communication System Design **FIRST SEMESTER (E-II)**

Introduction to RF and Wireless Technology: Complexity comparison, design bottleneck, choice of technology, mobile RF technology. Basic concepts in RF design, frequency and spectrum, nonlinearity and time Variance, intersymbol interference, sensitivity and dynamic range, basic impedance transformation.

Transceiver Architectures: Heterodyne receivers, homodyne receivers, image-reject receivers, digital-IF receivers, subsampling receivers, direct-conversion techniques, two-step transmitters, case studies – Motorola's FM receiver, Phillips' DECT transceiver, Lucent Technologies GSM transceiver, Phillips GSM transceiver.

Amplifiers, Mixers and Oscillators: High frequency amplifiers, low noise amplifiers, power amplifiers. Mixers: general considerations, transistor mixers, CMOS mixers, noise in mixers. Oscillators: general considerations, basic LC oscillator topologies, negative resistance oscillators, voltage controlled oscillators, phase noise, oscillator pulling and pushing, quadrature signal generation.

Frequency Synthesizers: General considerations, Phase-Locked Loop (PLL): basic PLL, charge-pump PLL, noise in PLL. RF synthesizer architectures, frequency dividers.

Design and computer simulation of a RF transceiver.

References:

1. B. Razavi, *RF microelectronics*, Prentice Hall, 1998
2. S. Haykin, *Communication Systems*, John-Wiley & Sons, 4th edition, 2000
3. R. Ludwig and P. Bretchko, *RF circuit design – theory and application*, Prentice Hall, 2000
4. C. W. Sayre, *Complete wireless design*, McGraw-Hill, 2001
5. S. Furber, *ARM System-on-Chip Architecture*, Addison-Wesley Professional, 2 edition, 2000

EC21327 Information Theory and Coding **FIRST SEMESTER (E-II)**

Information theory: Information, entropy, information rate, classification of codes, Kraft McMillan inequality, sources, memoryless and Markov, source coding theorem, ShannonFano coding, Huffman coding, Extended Huffman coding - joint and conditional entropies, mutual information, discrete memoryless channels – BSC, BEC – channel capacity, Shannon limit.

Source coding: text, audio and speech: Text: adaptive Huffman coding, arithmetic coding, LZW algorithm – Audio: perceptual coding, masking techniques, psychoacoustic model, MEG audio layers I,II,III, Dolby AC3 - Speech: channel vocoder, linear predictive coding.

Source coding: Image and Video: Image and video formats – GIF, TIFF, SIF, CIF, QCIF, Image compression: READ, JPEG, Video compression: principles- I,B,P frames, motion estimation, motion compensation, H.261, MPEG standard.

Error control coding - Block codes: Definitions and principles: Hamming weight, Hamming distance, Hamming Bound, minimum distance decoding, single parity codes, Hamming codes, repetition codes, linear block codes, cyclic codes, syndrome calculation, encoder and decoder, CRC.

Error control coding - Convolutional codes: Convolutional codes, code tree, trellis, state diagram, encoding, decoding: sequential search and Viterbi algorithm, principle of Turbo coding.

References:

1. R Bose, *Information Theory, Coding and Crptography*, TMH 2007
2. Fred Halsall, *Multidedia Communications: Applications, Networks, Protocols and Standards*, Pearson Education Asia, 2002
3. K Sayood, *Introduction to Data Compression*, 3/e, Elsevier 2006
4. S Gravano, *Introduction to Error Control Codes*, Oxford University Press 2007
5. Amitabha Bhattacharya, *Digital Communication*, TMH 2006
6. B. P. Lathi, *Modern Digital and Analog Communications Systems*, The Oxford Series in Electrical and Computer Engineering, Third Edition
7. Thamas Cover, *Information theory and Coding*, 2nd Edition, Prentice Hall

EC21328 VLSI for Communication **FIRST SEMESTER (E-II)**

Review of communication concepts from circuit designer perspective. General VLSI optimization techniques, partitioning and synthesis of different telecommunication blocks. Telecommunication system integration in single chip/ multichip module, high throughput and low delay/latency design requirement for real time communication, critical path analysis for high speed VLSI design, switched capacitor circuits, high speed A/D and D/A converters. Receiver architectures for different systems. Active and passive mixers. Frequency synthesizer circuits.

VLSI CAD tools, softwares and languages, low power circuits/architecture design methodologies, high speed switching circuits, high speed memory organization, high speed control & decision circuits, design of analog front ends, impedance matching with bonding pads, Si-Ge devices for RF circuits, interface for optical fibres.

VLSI for generation and detection of PSK, FSK, QAM etc,, subscriber line interface circuits, network switching circuits, VLSI systems for modem design, adaptive filters, equalizers, CVSD codecs, PLL, ISDN, UDLT, USART, Viterbi decoding, data encryption, DSPs, audio/video compression, video conferencing, Case studies for implementation of specific protocols currently in vogue.

VLSI design and optimization of switch architecture for next generation networks. Soft switch design and its performance issues.

References:

1. Jose Epifanio Franca and Yannis Tsividis, *Design of Analog-Digital VLSI Circuits for Telecommunications and Signal Processing,* (2nd Edition) Prentice Hall
2. Keshab K. Parhi, *VLSI Digital Signal Processing Systems: Design and Implementation*, Wiley-Interscience; 1 edition
3. Richard J. Higgins, *Digital signal processing in VLSI*, Prentice Hall

EC21211 Communication System Design Lab **FIRST SEMESTER (E-III)**

List of Experiments:

1. Introduction to SystemVue Simulator
2. Introduction to Testing Hardware
3. Analog Communication System Design (AM, FM)
4. Baseband Modulation and Demodulation
   - i. PAM
   - ii. Sinc PAM
   - iii. Raised Cosine PAM
   - iv. Optimum Binary Baseband Receiver
   - v. M-ary PAM
   - vi. Partial Response Signaling
   - vii. Delta Modulation
   - viii. Eye Diagrams
5. Bandpass Modulation and Demodulation
   - i. ASK, FSK, PSK
   - ii. M-ary ASK, FSK, PSK
   - iii. DPSK iv. QPSK
   - v. QAM
   - vi. Optimum Bandpass Receiver
6. Synchronization and Equalization
7. Software Defined Radio (SDR)
8. MIMO (2x2)

EC21212 Optical Communication Lab **FIRST SEMESTER (E-III)**

List of Experiments:

1. Characteristics of the Light-Emitting Diode
2. Characteristics of the Photodiode
3. Demonstration and study of different types of Optical Fibers and connectors
4. Fiber Splicing and Introduction to the OTDR
5. OTDR Measurement of Fiber Length, Attenuation and Splice Loss
6. Optical Power Measurements at different wavelength
7. Introduction to the optical Spectrum Analyzer
8. Introduction to the optical attenuator
9. Simulation, optimisation and physical properties of Optical Communication Systems

EC21213 RF and Microwave Lab **FIRST SEMESTER (E-III)**

List of experiments:

1. Study the characteristics of Reflex Klystron and to determine its electronic tuning range
2. Determine the frequency and wavelength in a rectangular waveguide working in TE_{10} mode
3. Measure the Standing Wave Ratio (SWR) and Reflection Coefficient
4. Measure an unknown impedance with Smith chart
5. Study V-I characteristics of GUNN diode
6. Study the function of directional coupler by measuring the following parameters
   a) Measure main line and main line VSWR
   b) Measure the coupling factor and directivity
7. Study of Magic Tee
8. Measure the polar pattern and gain of a Horn antenna
9. Simulation of basic microwave components
10. Simulation of microwave Antennas

EC22321 Radar and Satellite Communication — SECOND SEMESTER (E-IV)

Radar fundamentals- The Radar range equations, the search Radar equation, jamming and Radar range with jamming, Radar range with clutter, Radar range with combined interferences sources,

Radar Types- CW and FM Radar, FMCW Radar, Radar MTI Radar: MTI using range gates and filters, pulse Doppler Radar, Tracking Radar: different types of tracking techniques, tracking in range, tracking in Doppler

Radar signal Detection in noise – Fundamentals of radar signal processing, Theory of target detection: Noise and false alarms, detection of fluctuating targets, CFAR, Radar cross section of simple and complex objects.

Advancement in Radar system- pulse compression Radar, Height finding Radars, air traffic control, atmospheric effects of Radar, electromagnetic compatibility aspects, Airborne Radars, synthetic aperture Radar, Radar antennas

Satellite Orbits: Kepler's Laws, Newton's law, orbital parameters, orbital perturbations, station keeping, geo stationary and non geo-stationary orbits, look angle determination, limits of visibility, eclipse, sub Satellite point, Sun transit outage, launching procedures, launch vehicles and propulsion.

Space Segment and Satellite Link Design: Spacecraft technology, communication payload and supporting subsystems, telemetry, tracking and command. Satellite uplink and downlink analysis and design, link budget, E/N calculation, performance impairments, system noise, inter modulation and interference

Satellite Access: Modulation and Multiplexing: voice, data, video, analog–digital transmission system, digital video broadcast, multiple access spread spectrum communication, compression, encryption.

Earth Segment: Earth station technology, terrestrial interface, transmitter and receiver, antenna systems, test equipment measurements on G/T, C/No, EIRP, antenna gain.

Satellite Applications: INTELSAT series, INSAT, VSAT, Mobile satellite services, Satellite navigational system. Direct broadcast satellites (DBS), digital audio broadcast (DAB)- World space services, business ***References:***

1. David Barton K, *Modern radar system analysis*, Artech house, 1988
2. Fred Nathanson e, *Radar design principles signal processing and the environment*, McGraw Hill.1969

3. Cook CE and Bernfield. M, *Radar signals*, Academic press, 1967
4. Skolnik, *Introduction to radar systems*, Mcgraw hill, 2nd Edition 2003
5. G. Maral and M. Bousquet, *Satellite Communication Systems*, John Wiley and Sons, Inc., 1999
6. Timothy Pratt, Charles Bostian and Jeremy Allnutt, *Satellite Communications*, John Wiley, 2003
7. Dennis Roddy, *Satellite Communications*, 3rd edition, McGraw- Hill, 2001
8. J. J Spilker, *Digital Communications by Satellites*, Prentice Hall, 1977 9. Gagliardi, *Satellite Communication*, CBS

EC22322 Image Processing and Pattern Recognition **SECOND SEMESTER (E-IV)**

Human visual system and image perception, image representation and modelling, image sampling and quantization, 2D systems, Image transforms: KLT, DFT, DCT, DST, Hadamard, Harr and Slant transform, image data compression, pixel coding, predictive coding and transform coding, JPEGF Standard, image representation by stochastic model, image enhancement, filtering and restoration, image analysis using multi restoration techniques, texture analysis and synthesis, scene analysis decision theory, parametric and nonparametric procedures for classifying patterned data sets, sets clustering and unsupervised learning, knowledge based pattern recognition.

References:

1. Rafael C. Gonzalez and Richard E. Woods, *Digital Image Processing*, Pearson, Second Edition, 2004
2. Kenneth R. Castleman, *Digital Image Processing*, Pearson, 2006
3. William K. Pratt, *Digital Image Processing*, John Wiley, New York, 2002
4. Rafeal C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Second Edition, Pearson Education

EC22323 Wireless Sensor Networks **SECOND SEMESTER (E-IV)**

Introduction: The wireless sensor network concept, architectural elements, challenges, constraints, applications.

Technologies for Wireless Sensor Network: Wireless sensor node architecture, sensor node technology, hardware and software, sensor taxonomy, wireless network operating environment, wireless network trends, transmission technology.

Network deployment & configuration: Classification of network deployment strategy, localization and calibration, coverage and connectivity.

Wireless Communications: Link quality, shadowing and fading effects, medium access, scheduling sleep cycles, power management, time synchronization.

Data Gathering: Tree construction algorithms and analysis, asymptotic capacity, lifetime optimization formulations.

Routing and Querying: Publish/Subscribe mechanisms, geographic routing, robustness, storage and retrieval.

Security: Fundamentals of network security, challenges of security in wireless sensor networks, security attacks in sensor networks, protocols and mechanisms for security.

References:

1. Waltenegus Dargie and Christian Poellabauer, *Fundamentals of Wireless sensor Networks Theory and practice*, Eieley Series on wireless Communications and Mobile Computing
2. Kazem Sohraby, Daniel Minoli and Taieb Znati., *Wireless Sensor Networks: Technology, Protocols, and Applications,* Wiley
3. Feng Zhao and Leonidas Guibas, *Wireless Sensor Networks, An Information Processing Approach*, Morgan Kaufmann
4. Jun Zheng and Abbas Jamalipour, *Wireless Sensor Networks: A Networking Perspective*, Wiley
5. Ian F. Akyildiz and Mehmet Can Vuran, *Wireless Sensor Networks*, Wiley
6. Waltenegus Dargie and Christian Poellabauer, *Fundamentals of Wireless Sensor Networks: Theory and Practice*, Wiley

EC22324 Advance Signal and Image Processing **SECOND SEMESTER (E-IV)**

Basics of Multirate systems and their application, up sampling and down sampling, fractional sampling rate converter, polyphase decomposition, efficient realization of multirate systems, uniform filter banks and its implementation using polyphase decomposition.

Power spectrum estimation of signals: Wide sense stationary random processes, power spectral density, Non parametric methods: periodogram, Backman-Tuckey method. Parametric method: ARMA, AR processes, Yule-Walker method.

2D systems and mathematical preliminaries, linear operations on images, digital representation of binary & gray scale and colour images. Fundamental steps in image processing, elements of digital image processing systems, some basic relationship between pixels. Image sampling and quantization: 2D sampling on rectangular and nonrectangular sampling lattice, aliasing, image quantization, visual quantization

Image transforms: 2D orthogonal and unitary transforms, basis image, properties of unitary transforms, 1D and 2D discrete fourier transform and its properties, DCT, DST and its properties, Walsh, Hadamard transform, Harr & Slant transform and KLT. Fundamentals of Wavelet transform and it application. Image analysis using multi-resolution techniques.

Image Enhancement Techniques: Spatial domain and frequency domain methods, Gray scale transformation, Histogram matching and equalization, Smoothening: noise removal, averaging, median, min/max. Filtering, sharpening of images using differentiation, the Laplaciam, high emphasis filtering, edge detection. Image restoration: degradation model, averaging, inverse and Wiener filtering.

Image Data Compression, Image redundancies, lossy and lossless compression, pixel coding, predictive coding, Fidelity criteria. DCT and Wavelet based transform coding schemes, Huffman, Run-length and arithmetic coding, JPEG and JPEG2000.

Image Segmentation: Line and edge detection, detection of discontinuities, edge labelling and boundary detection, edge linking, Hough Transform, thresholding histogram technique.

Image segmentation using similarities: region growing, split and merge.

References:

1. Sanjit K. Mitra, *Digital Signal Processing: A Computer Based Approach*, 3e, McGraw Hill
2. S. M. Kay, *Fundamentals of Statistical Signal Processing*
3. R. C. Gonzalez and Richard E. Woods, Digital Image Processing
4. A. K. Jain, *Fundamentals of Digital Image Processing*
5. J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms, and Applications*
6. C. Rafel and Paul Wintz, *Digital Image Processing*
7. A. Rosenfield and A.C. Kak, *Digital Picture Processing*

8. N. Ahmad and K. R. Rao, Orthogonal Transform for Digital Signal Processing
9. Alan V. Oppenheim, Ronald W. Schafer, and John R. Buck, *Discrete-Time Signal Processing*
10. *A. M. Tekalp,* Digital Video Processing, Prentice-Hall, 1995

EC22325 Detection and Estimation Theory **SECOND SEMESTER (E-V)**

Review of Gaussian variables and processes; problem formulation and objective of signal detection and signal parameter estimation in discrete-time domain.

Statistical Decision Theory: Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Detection of Deterministic Signals: Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

Detection of Random Signals: Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Nonparametric Detection: Detection in the absence of complete statistical description of observations, sign detector, Wilcoxon detector, detectors based on quantized observations, robustness of detectors.

Estimation of Signal Parameters: Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Signal Estimation in Discrete-Time: Linear Bayesian estimation, Weiner filtering, dynamical signal model, discrete Kalman filtering.

References:

1. H. L. Van Trees, *Detection, Estimation and Modulation Theory: Part I, II, and III*, John Wiley, NY, 1968.
2. H. V. Poor, *An Introduction to Signal Detection and Estimation*, Springer, 2/e, 1998.

3. S. M. Kay, *Fundamentals of Statistical Signal Processing: Estimation Theory*, Prentice Hall PTR, 1993.
4. S. M. Kay, *Fundamentals of Statistical Signal Processing: Detection Theory*, Prentice Hall PTR, 1998.

EC22326 Antenna Design and MIMO systems **SECOND SEMESTER (E-V)**

Overview of Antennas: Introduction, types of antennas, radiation mechanism of single wire, two wire, dipoles.

Fundamental parameters of antennas: Radiation pattern, radiation power density, radiation intensity, beamwidth, directivity, antenna efficiency, beam efficiency, bandwidth, polarization, input impedance, antenna radiation efficiency, maximum directivity and maximum effective area, antenna temperature, reciprocity, Friis transmition formula.

Wire antennas and Aperture Antennas: Short dipole, Half Wave dipole, monopole, small loop antennas, slot antennas, open ended waveguide radiator, Horn antennas, pyramidal Horn antenna, reflector antenna.

Antenna Arrays and Special Antennas: Linear array and pattern multiplication, two element array, uniform array, array with non-uniform excitation.

Special Antennas and Antenna for mobile devices: Monopole and dipole antennas, long wire, V and Rhombic antennas, Yagi-Uda array, Turnstile antenna, Helical antenna, Biconical antenna, Log-periodical array, spiral antenna, microstrip patch antenna, loop antenna, lens antenna. PIFA, integral IFA, internal folded monopole, ceramic antennas, stubby antennas and whip stubby antennas.

MIMO antenna systems: Introduction, diversity antennas, key to gigabyte wireless, current issues and challenges of MIMO antenna design, impact of antenna on MIMO performance, MIMO signalling.

References:

1. C A Balanis, *Antenna Theory: Analysis and Design*, 3rd Edition Wiley, 2009
2. John D Kraus, Ronald J Marhefka and Ahmad S Khan T, *Antennas and Wave Propagation*, 4th Edition, Tata McGraw-Hill Education, 2006
3. Constantine A. Balanis, Michael A. Jensen and Jon W. Wallace, *Antenna Design Considerations for MIMO and Diversity Systems*, WILEY Pub, 2010
4. Mohammad S. Sharawi, *Printed MIMO Antenna Engineering*, Artech House, 2014

5. Garg, P. Bhartia, Inder Bahl and A. Ittipiboon, *Microstrip Antenna Design Handbook*, Artech House Publishers , 2000

EC22306 Embedded Systems **SECOND SEMESTER (E-V)**

Introduction to an Embedded systems design: Introduction to Embedded system (ES), Embedded system project management, ESD and co-design issues in system development process, design cycle in the development phase for an embedded system, use of target system or its emulator and in-circuit emulator, use of software tools for development of an ES. **RTOS & its overview:** Real time operating system: Task and task states, tasks and data, semaphores and shared data operating system, services, message queues, timer function, events, memory management, interrupt routines in an RTOS environment, basic design using RTOS.

Microcontroller: Role of processor selection in embedded system (Microprocessor vs Microcontroller), 8051 Microcontroller: architecture, basic assembly language programming concepts, instruction set, addressing modes, logical operation, arithmetic operations, subroutine, interrupt handling, timing subroutines, serial data transmission, serial data communication.

Embedded System Development: Embedded system evolution trends. Round - Robin, robin with interrupts, function-one-scheduling architecture, algorithms. Introduction to assembler-compiler-cross compilers and Integrated Development Environment (IDE). object oriented interfacing, recursion, debugging strategies, simulators.

Networks for Embedded Systems: The I^2C Bus, The CAN bus, SHARC link ports, Ethernet, Myrinet, Internet, Introduction to Bluetooth: specification, core protocol, cable replacement protocol. IEEE 1149.1 (JTAG) Testability: boundary scan architecture.

References:

1. Raj Kamal, *Embedded Systems*, TMH
2. K.J. Ayala, *The 8051 Microcontroller,* Penram International
3. J B Peatman, *Design with PIC Microcontrollers*, Prentice Hall
4. David E. Simon,*An Embedded Software Primer*, Pearson Education
5. John Catsoulis, *Designing Embedded Hardware*,O'reilly,
6. Frank Vahid, Tony Givargis, *Embedded System Design*, John Wiley & Sons, Inc

7. Karim Yaghmour,*Building Embedded Linux Systems*, O'reilly
8. Michael Barr, *Programming Embedded Systems,*O'reilly
9. Alan C. Shaw, *Real-time systems & software,* John Wiley & sons, Inc.

EC22328 Artificial Intelligence and Machine Learning **SECOND SEMESTER (E-V)**

Basic Principles: Introduction, Experimental Evaluation: Over-fitting, Cross-Validation. Sample complexity. VC-dimension, Regularization, Theory of generalization, Bias-Variance trade off, Reinforcement Learning.

Supervised Learning: Linear and Logistic Regression, Decision Tree Learning, k-NN classification, SVMs, Ensemble learning: boosting, bagging.

Neural Network: Artificial Neural Networks: Perceptron, Multilayer networks and backpropagation. Radial Basis function NN

Probabilistic Models: Maximum Likelihood Estimation, MAP (Maximum a-posteriori), Bayes Classifiers, Naive Bayes. Markov Networks, Bayesian Networks, Factor Graphs, Inference in Graphical Models.

Unsupervised Learning: K-means and Hierarchical Clustering, Gaussian Mixture Models, PAC learning. EM algorithm, Hidden Markov Models.

References:

1. Tom Mitchell, *Machine Learning*, McGraw Hill, 1997.
2. Christopher M. Bishop, *Pattern Recognition and Machine Learning*, Springer 2006.
3. Richard O. Duda, Peter E. Hart, David G. Stork, *Pattern Classification*, John Wiley & Sons, 2006.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*, Springer 2009.

EC22211 Data Communication Networks Lab **SECOND SEMESTER (E-VI)**

List of experiments using QUALNET Simulator:

1. To understand half duplex communication in the wired medium.
2. To build and configure a simple wired network of four nodes connected with point-topoint links.

3. To evaluate the performance of AODV routing protocol for wireless adhoc Network.
4. To evaluate the performance of AODV routing protocol for MANET Network.
5. To evaluate the performance of AODV routing protocol with and without HELLO message.
6. Compare the performance of AODV, DSR, DYMO routing protocols for wireless networks; (performance parameters: average jitter, end-to-end delay, throughput, energy consumption at the node).
7. To evaluate the performance of different MAC layer protocols for wireless networks such as ALOHA, TDMA, CSMA, 802.11; (performance parameters: average jitter, end-to-end delay, throughput, energy consumption at the node).
8. To evaluate the performance of different MAC layer protocols for wireless networks such as MACA, 802.11e and Generic MAC; (performance parameters: average jitter, end-to-end delay, throughput, energy consumption at the node).
9. To simulate the data transfer services of TCP and UDP transport layer protocols.

List of Experiments using NS-2 Simulator:

1. To understand node creation.
2. To create UDP data traffic in wired scenario.
3. To analysis the trace files.
4. To create TCP data traffic.
5. To create wireless scenario.
6. To create UDP data traffic in wireless scenario.
7. To understand movement generation and random topology.
8. To understand new wireless trace file analysis.
9. To understand energy model and XGRAPH.
10. To understand random traffic creation.

EC22212 Advance Communication Lab **SECOND SEMESTER (E-VI)**

List of Experiments:

1. Perform the generation of Pseudo Random Binary Sequence (PRBS)
    a) Determine its chip rate L_C
    b) Check whether a DSSS signal is a BPSK signal or not

2. Perform PCM generation and demodulation
3. Study and implement Digital Phase Detector and to detect the phase difference between two sinusoidal waves
4. Perform Amplitude Shift Keying (ASK) modulation and demodulation
5. Perform Binary Frequency shift Keying (BFSK) modulation and demodulation
6. Perform Binary Phase shift Keying (BPSK) modulation
7. Study the transmission and reception of data and voice signal via transponder using satellite communication system kit
8. Study transmission and reception of data in text and ASCII mode through Optical Communication Kit
9. Test the various AT commands on GSM evaluation kit for IMSI information along with performing evaluation of Low-pass, High-pass, Band-pass and Notch Filter using spectrum analyzer (analog)
10. Study and perform the operation of Phase Locked Loop (PLL)
11. Design and test the circuit of voltage to frequency converter (VCO) using IC 555
12. Design and test a Mixer circuit using PLL IC 565
13. Perform FPGA implementation of:
    a) ASK b) BPSK c) BFSK
14. Study and implement frequency synthesizer
15. Study and implement Squelch Circuit
16. Study and implement Amplitude Modulation (AM) and Frequency Modulation (FM)
17. Study and implement PAM, PPM and PWM

EC22213 Advanced Digital Signal and Image Processing Lab

SECOND SEMESTER (E-VI)

List of experiments:

Experiment 1: **Speech Processing**

A speech processing experiment, separated into two parts:

In this experiment the students will become familiar with speech signals, their statistical properties and built a model that represents the production of such a signal.

- An encoder-decoder system will be built and tested using Matlab.

- The blocks that assemble such systems are VAD (Voice Activity Detection), voiced/unvoiced classifier, pitch (the basic frequency of speech) detector and a parametric model of a speech signal.

Experiment 2: **Real-time Implementation of Digital Filters**

A Real-time experiment based on Texas Instrument's TMS320c6713, a well known and wide used DSP. The experiment is separated into two parts:

- Digital filter (FIR) design, with special attention to quantization and fixedpoint implementation.
- Comparison of FIR and IIR filters design, with DFT/FFT usage example, by tuning piano tones.

Experiment 3: **Image Compression**

In this experiment the students will become familiar with the basics and principles of image processing and compression techniques, specifically with the well known and widely used JPEG standards. The experiment is separated into two parts:

- Feature extraction and other image processing operations.
- Image basics, terminology and techniques used for image processing and compression are learned. This part includes a "JPEG-like" Matlab based implementation of these basic ideas.

Experiment 4: **Wavelet and Multirate Signal Processing**

- Up-sampler and down-sampler, filters in sampling rate alternation systems, multi-stage design of decimator and interpolator, polyphase decomposition, arbitrary sampling rate converter, digital filter banks, uniform DFT filter banks, Wavelet transform and its applications.