EC6301: Random Processes

Total Hours : 56 Hrs.

Random variables representation and manipulation, independent and uncorrelated variables, functions of random variables, standard PDFs, first and second fundamental theorems in probability. Random process, stationarity and ergodicity, power spectral density, response of LTI systems to random process, white Gaussian noise, Markov chains and series representation of random process.

EC6302: Digital Communication Techniques

Pre-requisite: A first course in ‘Digital Communication’ at the undergraduate level

Total Hours : 56 Hrs.


EC6303: Information Theory

Pre-requisite: A first course in Probability Theory and Random Processes

Total Hours : 56 Hrs.

Representation of discrete sources, Entropy, Lossless source coding- Uniquely decodable codes- Optimal codes- Huffman code- Shannon's Source Coding Theorem, Asymptotic Equipartition Property, Discrete channels- Channel Capacity- Arimoto- Blahut algorithm, Proof of Shannon's Channel Coding Theorem and its converse, Joint source channel coding Theorem, Modeling of continuous sources and channels, Differential Entropy, Mutual information, Mutual information and Capacity calculation for Band limited Gaussian channels- Shannon limit- Parallel Gaussian Channels-Capacity of channels with colored Gaussian noise- Water filling. Introduction to Rate Distortion Theory- Continuous Sources and Rate Distortion measure- Rate Distortion Theorem.
EC6304: Communication Networks

Pre-requisite: A basic course in Computer Networks

Total Hours : 42 Hrs.

Internet Architecture: Application layer, Transport layer, Network layer, Link Layer- protocol stack. Broadband services and Quality of Service issues in networks- Queuing Disciplines - Weighted Fair Queuing - Random Early Detection - Differentiated Services - Multi protocol Label switching - Discrete time and continuous time Markov chains- Poisson process- Queuing models for Datagram networks- M/M/1 queuing systems- M/M/m/m queuing models- M/G/1 queue- Mean value analysis- Time reversibility- Closed queuing networks- Jackson's Networks.

EC6305: Telecommunication Lab I

Pre-requisite: EC 6301, EC 6302 & EC 6304

Total Hours : 42 Hrs.


EC6306: Theory of Error Control Coding

Pre-requisite: A basic course in Digital Communication

Total Hours : 56 Hrs.


EC6307: Estimation & Detection Theory

Pre-requisite: Linear algebra, Random Process

Total Hours : 56 Hrs.


**EC6308: Telecommunication Lab II**

**Pre-requisite:** EC6304 Communication Networks and EC6306 Theory of Error Control Coding.

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**Total Hours:** 42 Hrs.


**EC6321: Wireless Communication**

**Pre-requisite:** Digital Communication Techniques

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**Total Hours:** 42 Hrs.


**EC6322: Secure Communication**

**Pre-requisite:** Basic Course in Information Theory and Coding

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**Total Hours:** 42 Hrs.

EC6323 : Optical Communication

Total Hours : 42 Hrs.

Wave propagation through optical fibers, attenuation and dispersion, dispersion shifted and dispersion flattened fibers, Kerr nonlinearity, LED and laser diodes, photodetectors, typical receiver configurations, homodyne and heterodyne systems, performance degradation, optical amplifiers, semiconductor amplifier, doped fiber amplifier, Raman and Brillouin amplifiers, characteristics of amplifiers

EC6324: Selected Topics in Networks

Pre-requisite: EC6304 Communication Networks, EC6321 Wireless Communication

Total Hours : 42 Hrs.


EC6325: MIMO Communication Systems

Pre-requisite: EC6303 and EC6321

Total Hours : 42 Hrs.

MIMO channel capacity results and effect channel models on capacity. Formulation of capacity for slow fading channels. Diversity gain and array gain in MIMO systems. Methods to achieve transmit and receive diversity. Receiver design for MIMO systems. Diversity multiplexing trade off formulation. Design criteria for space time block codes, existence of space time block codes. Space time trellis codes and performance analysis.

EC6326: Markov Modeling & Theory of Queues

Pre-requisite: EC6301 Random Processes

Total Hours : 42 Hrs.

Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Markov Models: Discrete Time Markov Chain; Continuous Time Markov Chain - Pure-Jump Continuous-Time Chains, Regular Chains, Birth and Death Process, Semi-Markov Processes; Single Class & Multi-class Queuing Networks: Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.
EC 6327: Spread Spectrum & CDMA Systems

Pre-requisite: EC 6321 and EC 6302  

Total Hours : 42 Hrs.


EC 6328: Communication Switching & Multiplexing

Pre-requisite: EC 6304 Communication Networks  

Total Hours : 42 Hrs.


EC 6329: Selected Topics in Communication

Pre-requisite: EC 6304 Communication Networks, EC 6321 Wireless Communication & EC 6302 Digital Communication Techniques  

Total Hours : 42 Hrs.


EC 6330: Network Security

Pre-requisite: EC 6304 Communication Networks  

Total Hours : 42 Hrs.

Detailed Syllabi

EC6301: Random Processes

Total Hours : 56 Hrs

Module 1: (14 hours) Random Variables
Probability axioms, conditional probability, discrete and continuous random variables, cumulative distribution function (CDF), probability mass function (PMF), probability density function (PDF), conditional PMF/PDF, expected value, variance, functions of a random variable, expected value of the derived random variable, multiple random variables, joint CDF/PMF/PDF, functions of multiple random variables, multiple functions of multiple random variables, independent/uncorrelated random variables, sums of random variables, moment generating function, random sums of random variables.

Module 2: (14 hours) Fundamental Theorems and Random Processes
The sample mean, laws of large numbers, central limit theorem, convergence of sequence of random variables. Introduction to random processes, specification of random processes, $n$th order joint PDFs, independent increments, stationary increments, Markov property, Markov process and martingales, Gaussian process, Poisson process and Brownian motion.

Module 3: (14 hours) Response of Processes to LTI Systems
Mean and correlation of random processes, stationary, wide sense stationary and ergodic processes. Random processes as inputs to linear time invariant systems: power spectral density, Gaussian processes as inputs to LTI systems, white Gaussian noise. In-Phase and quadrature representation of random processes.

Module 4: (14 hours) Other Topics

References

EC6302 : Digital Communication Techniques

Pre-requisite: A first course in ‘Digital Communication’ at the undergraduate level

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Total Hours : 56 Hrs.

Module 1: (10 hours) Random Variables and Processes
Review of Random variables: Moment generating function, Chernoff bound, Markov’s inequality, Chebyshev inequality, Central limit Theorem, Chi square, Rayleigh and Rician distributions, Correlation, Covariance matrix- Stationary processes, wide sense stationary processes, ergodic process, cross correlation and autocorrelation functions-Gaussian process

Module 2: (22 hours) Communication over Additive Gaussian Noise Channels
Characterization of Communication Signals and Systems- Signal space representation- Connecting Linear Vector Space to Physical Waveform Space- Scalar and Vector Communication over Memory less Channels. (4 hours)
Optimum waveform receiver in additive white Gaussian noise (AWGN) channels - Cross correlation receiver, Matched filter receiver and error probabilities. (6 hours)
Optimum Receiver for Signals with random phase in AWGN Channels- Optimum receiver for Binary Signals- Optimum receiver for M-ary orthogonal signals- Probability of error for envelope detection of Mary Orthogonal signals. (6 hours)
Optimum waveform receiver for coloured Gaussian noise channels- Karhunen Loeve expansion approach, whitening. (6 hours)

Module 3: (12 hours) Synchronization in Communication Systems

Module 4: (12 hours) Communication over Band limited Channels
Communication over band limited Channels- Optimum pulse shaping- Nyquist criterion for zero ISI, partial response signaling- Equalization Techniques- Zero forcing linear Equalization- Decision feedback equalization- Adaptive Equalization..

References

EC 6303: Information Theory

Pre-requisite: A first course in Probability Theory and Random Processes

Total Hours : 56 Hrs.

Module 1: (14 hours) Entropy and Loss less Source coding

Module 2 (15 hours) Channel Capacity and Coding Theorem
Asymptotic Equipartition Property (AEP)- High probability sets and typical sets- Method of typical sequence as a combinatorial approach for bounding error probabilities.
Channel Capacity- Capacity computation for some simple channels- Arimoto-Blahut algorithm- Fano's inequality- Proof of Shannon's Channel Coding Theorem and its converse- Channels with feed back- Joint source channel coding Theorem.

Module 3: (15 hours) Continuous Sources and Channels
Differential Entropy- Joint, relative and conditional differential entropy- Mutual information- Waveform channels-Gaussian channels- Mutual information and Capacity calculation for Band limited Gaussian channels- Shannon limit- Parallel Gaussian Channels-Capacity of channels with colored Gaussian noise- Water filling.

Module 4: (12 hours) Rate Distortion Theory
Introduction - Rate Distortion Function - Properties - Continuous Sources and Rate Distortion measure- Rate Distortion Theorem - Converse - Information Transmission Theorem - Rate Distortion Optimization.

References
3. T. Bergu, “Rate Distortion Theory a Mathematical Basis for Data Compression” PH Inc. 1971.
EC6304: Communication Networks

Pre-requisite: A basic course in Computer Networks

Total Hours : 42Hrs.

Module 1 (10 hrs)
Introduction: General issues in networking; architectural concepts in ISO's OSI layered model- Data link layer - Direct Link Networks- Error detection- Reliable Transmission-ARQ schemes and analysis, multiple access, LANs, CSMA/CD, IEEE 802.11 wireless LANs

Module 2 (10 hrs)

Module 3 (10 hours)

Module 4 (12 hours)
Introduction to Queuing theory: Markov chain- Discrete time and continuous time Markov chains- Poisson process- Queuing models for Datagram networks- Little's theorem- M/M/1 queuing systems- M/M/m/m queuing models- M/G/1 queue- Mean value analysis- Time reversibility- Closed queuing networks- Jackson's Networks.

References

EC6305 : Telecommunication Lab I

Pre-requisite: EC 6301, EC 6302 & EC 6304

Total Hours : 42 Hrs.

Course objective:
To experiment the concepts introduced in the courses EC6301 (Random Processes), EC 6302 (Digital Communication techniques) and EC6304 (Communication Networks)

Tools:
Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool.

Random Processes – Generation of discrete time i.i.d. random processes with different distributions (Bernoulli, Binomial, Geometric, Poisson, Uniform, Gaussian, Exponential, Laplacian, Rayleigh, Rician) - pmf/pdf estimation, AR, MA and ARMA processes - spectral estimation - Visualization of Central Limit Theorem, Whitening Filter.

Communication system Design for Band limited Channels - Signal Design for Zero ISI and Controlled ISI - Partial Response Signaling.

Carrier Phase Modulation and Quadrature Amplitude Modulation - BER Performance in AWGN channel.

Synchronization in Communication Systems: Carrier and Clock Synchronization- Frequency Offset Estimation and Correction.


TCP Connections- Congestion and Congestion Control Parameters.

MAC Protocols: CSMA and CSMA/CD in Ethernet and LAN Environments.

Multimedia Networking applications: RTSP and Transport of Video using UDP.

References

EC6306 : Theory of Error Control Coding

Pre-requisite: A basic course in Digital Communication

Total Hours : 56 Hrs.

Module 1: (12 hours) Finite Field Arithmetic

Module 2: (15 hours) Linear Block Codes
Linear Block codes- Properties- Minimum Distance- Error detection and correction- Standard Array and Syndrome decoding- Hamming codes- Perfect and Quasi-perfect codes- Extended codes- Hadamard codes.

Module 3: (10 hours) Cyclic Codes
Basic theory of Cyclic codes- Generator and Parity check matrices - Cyclic encoders- Error detection & correction decoding of cyclic codes- Cyclic Hamming codes- Binary Golay codes- BCH codes- Decoding of BCH codes-The Berlekamp- Massey decoding algorithm. Reed Solomon codes- Generalized Reed Solomon codes- MDS codes.

Module 4: (10 hours) Convolutional Codes
Generator matrices and encoding- state, tree and trellis diagram- Transfer function -- Maximum Likelihood decoding Hard versus Soft decision decoding- The Viterbi Algorithm- Free distance- Catastrophic encoders.

Soft Decision and Iterative Decoding (9 hours)
Soft decision Viterbi algorithm- Two way APP decoding- Low density parity check codes- Turbo codes- Turbo decoding

References

EC 6307: Estimation & Detection Theory

Pre-requisite: Linear algebra, Random Process

Total Hours: 56 Hrs.

Module 1: (13 Hrs) Fundamentals of Estimation Theory

Module 2: Estimation Techniques
Deterministic Parameter Estimation: Least Squares Estimation-Batch Processing, Recursive Least Squares Estimation, Best Linear Unbiased Estimation, Likelihood and Maximum Likelihood Estimation (9 Hrs)
Random Parameter Estimation: Bayesian Philosophy, Selection of a Prior PDF, Bayesian linear model, Minimum Mean Square Error Estimator, Maximum a Posteriori Estimation (6 Hrs)
State Estimation: Prediction, Single and Multistage Predictors, Filtering, The Kalman Filter (5 Hrs)

Module 3: (13 Hrs) Fundamentals of Detection Theory

Module 4: (10 Hrs) Detection of Signals in White Gaussian Noise (WGN)
Binary Detection of Known Signals in WGN, M-ary Detection of Known Signals in WGN, Matched Filter Approach, Detection of signals with Random Parameters

References
EC6308: Telecommunication Lab II

Pre-requisite: EC6304 Communication Networks and EC6306 Theory of Error Control Coding.

Total Hours :  42 Hrs.

Course objective:- To experiment the concepts introduced in the courses EC6304 Communication Networks and EC6306 Theory of Error Control Coding.

Tools:- Numerical Computing Environments – GNU Octave or MATLAB or any other equivalent tool and specialized tools line OPNET/NS-2 etc.

Channel Coding: Linear Block code and Convolutional codes - Viterbi Decoding – Majority Logic Decoders - CRC-32- Modeling and Simulation of Radio Channels - Multipath Fading Channels- Jake’s Model- Frequency non-selective and frequency selective fading channels realization.


Scheduling and Queuing Disciplines in Packet Switched Networks: FIFO, Fair Queuing, RED- TCP Performance: with and without RED.


References

EC 6321: Wireless Communication

Pre-requisite: Digital Communication Techniques

Total Hours :  42 Hrs

Module 1: Fading and Diversity (14 hours)
Wireless Channel Models- Path loss and Shadowing models, Statistical fading models, Narrow band and wideband fading models, Review of performance of digital modulation schemes over wireless channels
Diversity- Time diversity, Frequency and Space diversity, Receive diversity, Concept of diversity branches and signal paths, Performance gains, Combining methods- Selective combining, Maximal ratio combining, Equal gain combining, performance analysis for Rayleigh fading channels, Transmit Diversity-Alamouti Scheme

Module 2: Cellular Communication (10 hours)

Module 3: Spread spectrum and CDMA(10 hours)
Motivation- Direct sequence spread spectrum (DS-SS), Frequency hopping spread spectrum (FH-SS), ISI and Narrow band interference rejection, Code design- Maximal length sequences, Gold codes- Walsh codes Diversity in DS-SS systems- Rake Receiver- Performance analysis, CDMA Systems- Interference Analysis for Broadcast and Multiple Access Channels, Capacity of cellular CDMA networks, Reverse link power control, Hard and Soft hand off strategies.

Module 4: Capacity and Standards (4 hours)
Capacity of Wireless Channels- Capacity of flat and frequency selective fading channels

Cellular Wireless Communication Standards (4 hours)

References

EC6322 : Secure Communication

Pre-requisite: Basic Course in Information Theory and Coding

Total Hours : 42 Hrs.

Module 1: (10 hours)
Rings and fields - Homomorphism- Euclidean domains - Principal Ideal Domains - Unique Factorization Domains -- Field extensions- Splitting fields - Divisibility- Euler theorem - Chinese Remainder Theorem - Primalty

Module 2: (11 hours)
Basic encryption techniques - Concept of cryptanalysis - Shannon's theory - Perfect secrecy - Block ciphers - Cryptographic algorithms - Features of DES – Linear and Differential Cryptanalysis – AES - Stream ciphers - Pseudo random sequence generators – linear complexity - Non-linear combination of LFSRs - Boolean functions – Cryptanalysis of LFSR based stream ciphers

Module 3: (11 hours)
Private key and Public key cryptosystems - One way functions - Discrete log problem – Factorization problem - RSA encryption - Diffie Hellmann key exchange - Message authentication and hash functions - Digital signatures - Secret sharing - features of visual cryptography - other applications of cryptography -

Module 4: (10 hours)
Elliptic curves - Basic theory - Weirstrass equation - Group law - Point at Infinity - Elliptic curves over finite fields - Discrete logarithm problem on EC - Elliptic curve cryptography – Integer factorization - Diffie Hellmann key exchange over EC - Elgamal encryption over EC - ECDSA

References


EC6323: Optical Communication

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Total Hours : 42 Hrs

Module 1: (10 hours)
Solution to Maxwell’s equation in a circularly symmetric step index optical fiber, linearly polarized modes, single mode and multimode fibers, concept of V number, graded index fibers, total number of guided modes (no derivation), attenuation mechanisms in fibers, dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation.

Module 2: (9 hours)
Optical sources - LED and laser diode - Principles of operation, concepts of line width, phase noise, switching and modulation characteristics. Optical detectors - pn detector, pin detector, avalanche photodiode - Principles of operation, concepts of responsivity, sensitivity and quantum efficiency, noise in detection, typical receiver configurations (high impedance and trans-impedance receivers).

Module 3: (12 hours)
Coherent systems - Homodyne and heterodyne systems, coherent systems using PSK, FSK, ASK and DPSK modulations, related noise effects, performance degradation induced by laser phase and intensity noise, degradation due to fiber dispersion, degradation induced by nonlinear effects in fiber propagation.

Module 4: (11 hours)
Optical amplifiers - semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier - principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, intermodulation effects, saturation induced crosstalk, wavelength range of operation.
EC6324 : Selected Topics in Networks

Pre-requisite: EC6304 Communication Networks, EC6321 Wireless Communication

Total Hours : 42 Hrs.

Module 1 (12 hours)
Wireless LANs and PANs: IEEE 802.11 WLANs - protocol architecture, physical layer, MAC layer, analysis, deployment of 802.11 infrastructure; WPANs – Bluetooth, ZigBee, UWB.

Module 2 (10 hours)
Mobile Network and Transport Layers: Mobile IP; Traditional TCP, Indirect TCP, Snooping TCP, Mobile TCP; TCP/IP protocol stack over IEEE 802.11b; wireless adaptation layer (WAL).

Module 3 (10 hours)
Mobile Ad-Hoc Networks (MANETS): Introduction; MAC Protocols - classification, comparative analysis; Routing - reactive and proactive routing, power-aware routing, performance comparison; Quality of Service.

Module 4 (10 hours)
Wireless Sensor Networks (WSNs): Overview/Architectures; Data Dissemination/Data Gathering; MAC Protocols; Power control; cross layer design; Localization.

References
EC6325 : MIMO Communication Systems

Pre-requisite: EC6303 and EC6321

Total Hours : 42 Hrs.

Module 1: (12 hours) Information Theoretic aspects of MIMO
Review of SISO fading communication channels, MIMO channel models, Classical i.i.d. and extended channels, Frequency selective and correlated channel models, Capacity of MIMO channels, Ergodic and outage capacity, Capacity bounds and Influence of channel properties on the capacity.

Module 2: (12 hours) MIMO Diversity and Spatial Multiplexing
Sources and types of diversity, analysis under Rayleigh fading, Diversity and channel knowledge. Alamouti space time code, MIMO spatial multiplexing. Space time receivers. ML, ZF, MMSE and Sphere decoding, BLAST receivers and Diversity multiplexing trade-off.

Module 3: (9 hours) Space Time Block Codes
Space time block codes on real and complex orthogonal designs, Code design criteria for quasi-static channels (Rank, determinant and Euclidean distance), Orthogonal designs, Generalized orthogonal designs, Quasi-orthogonal designs and Performance analysis.

Module 4: (9 hours) Space Time Trellis Codes
Representation of STTC, shift register, generator matrix, state-transition diagram, trellis diagram, Code construction, Delay diversity as a special case of STTC and Performance analysis.

References

EC6326 : Markov Modeling & Theory of Queues

Pre-requisite: EC6301 Random Processes

Total Hours 42 Hrs.

Module 1: (12hrs)
Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Renewal Theorems. (12hrs)

Module 2: (10hrs)

Module 3: (10hrs)
Single Class & Multi-class Queuing Networks: Simple Markovian queues; M/G/1 queue; G/G/1 queue; Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Service time distributions; BCMP networks; Priority systems.

Module 4: (10hrs)
Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.

References

**EC6327: Spread Spectrum & CDMA Systems**

Pre-requisite: EC 6321: Wireless Communication/ EC6302 Digital communication techniques

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**Total Hours : 42 Hrs.**

**Module 1: (10 Hrs) Fundamentals of Spread Spectrum**
Introduction to spread spectrum communication, direct sequence spread spectrum, frequency-hop spread spectrum system. Spreading sequences- maximal-length sequences, gold codes, Walsh orthogonal codes- properties and generation of sequences. Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization-principles of serial search and match filter techniques.

**Module 2: (11 Hrs) Performance Analysis of SS system**
Performance of spread spectrum system in jamming environments- Barrage noise jamming, partial band jamming, pulsed noise jamming and single tone jamming. Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver

**Module 3: (13 Hrs) Capacity, Coverage and multiuser detection**
Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum multiple access outage, outage with imperfect power control, Erlang capacity of forward and reverse links. Multi-user Detection - MF detector, decorrelating detector, MMSE detector. Interference Cancellation: successive, Parallel Interference Cancellation, performance analysis of multiuser detectors and interference cancellers.

**Module 4: (8 Hrs) CDMA Systems**
General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards, Principles of Multicarrier communication, MCCDMA and MC-DS-CDMA.

**References**

EC6328 : Communication Switching & Multiplexing

Pre-requisite: EC6304 Communication Networks

Total Hours : 42 Hrs.

Module 1: (10 hours)

Module 2: (10 hours)

Module 3: (10 hours)
Multiplexing: Network performance and source characterization; Stream sessions in packet networks - deterministic analysis, stochastic analysis, circuit multiplexed networks; Elastic transfers in packet networks - adaptive bandwidth sharing.

Module 4: (12 hours)
Statistical multiplexing: blocking analysis in circuit multiplexed networks, with single rate or multirate traffic-Models for performance analysis of integrated packet networks; deterministic models, worst case analysis; stochastic models, large deviations analysis. The effective Bandwidth approach for Admission control - Models for traffic flow in packet networks, long range dependence and self similar processes.

References

EC6329: Selected Topics in Communication

Pre-requisite: EC6304 Communication Networks, EC6321 Wireless Communication & EC6302 Digital Communication Techniques

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Total Hours : 42 Hrs.

Module 1: (10 Hrs)

Module 2: (10 Hrs)

Module 3: (12Hrs)
Multicarrier Digital Communication: Introduction to OFDM- Modeling of OFDM for Time varying random channels- Clipping in Multicarrier Systems- Bit loading and Peak-to average Power ratio- Synchronization in OFDM Systems- Time & frequency offset-Timing and frame synchronization- Phase Noise effects- Channel estimation and Equalization- Channel Coding in OFDM Systems - OFDM based multiple access technologies.

Module 4: (10Hrs)
Multiuser Information Theory: Review of Information Theory- Basics Entropy, mutual information, AEP, Source & Channel Coding Theorems- Single User Gaussian Channels AWGN Channel, Parallel Channels, Fading Channels, MIMO channels- Multiple-Access Channels: Discrete Memory less, Gaussian, and MIMO. - Broadcast Channel: Discret Memory less, Degraded, Gaussian, and MIMO. Interference Channel: Discrete Memory less, Strong & Very Strong Interference, Gaussian. Relay Channel: Discrete Memory less, Degraded, and Gaussian.

References
EC6330: Network Security

Pre-requisite: EC6304 Communication Networks

Total Hours : 42 Hrs

Module 1: (10 hours)
Introduction: Basic objectives of cryptography, secret-key and public-key cryptography, Block ciphers: Modes of operation, DES and its variants, AES, linear and differential cryptanalysis, stream ciphers, message digest algorithms: properties of hash functions, MD5 and SHA-1, keyed hash functions, attacks on hash functions.

Module 2: (12 hours)

Module 3: (15 hours)

Module 4: (5 hours)
Wireless network security - WEP, WPA2 (802.11i), security in Bluetooth.

References