CURRICULUM AND SYLLABUS

M.Tech Electronics with Specialization in Wireless Technology

"Where Intelligence Merges with Technology"

College of Engineering Kidangoor

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Proposed Course Structure M.Tech. (Electronics) with Specialization in Wireless Technology

First Semester

Course Code	Name of Course	Internal Marks	Ext. Marks	Total Marks	C/E	Credits
CWT3101	Probability and Stochastic Processes	50	50	100	C	3
CWT3102	Wireless Communications	50	50	100	C	3
CWT3103	Antenna Systems	50	50	100	C	3
CWT3104	Digital Communication	50	50	100	E	3
CWT3105	Network routing algorithms	50	50	100	E	3
CWT3106	Optical and wire line Technology	50	50	100	E	3
CWT3107	MEMS	50	50	100	E	3
CWT3108L	Communication Simulation Lab	100	0	100	C	1
CWT3109L	Communication Lab with core course	100	0	100	E	1
CWT3110L	Embedded Lab	100	0	100	E	1

Second Semester

Course Code	Name of Course	Internal Marks	Ext. Marks	Total Marks	C/E	Credits
CWT3201	Cellular Mobile Communication	50	50	100	C	3
CWT3202	Electromagnetic Interference/ Electromagnetic Compatibility in System	50	50	100	C	3
CWT3203	Ad Hoc & Sensor Networks	50	50	100	C	3
CWT3204	Smart Antennas	50	50	100	E	3
CWT3205	Global Positioning Systems	50	50	100	E	3
CWT3206	Image and Video Processing	50	50	100	E	3
CWT3207	Broadband Wireless Technologies	50	50	100	E	3
CWT3208	Seminar	100	0	100	C	1
CWT3209L	Mobile Communication Lab	100	0	100	E	1
CWT3210L	Wireless and Ad Hoc Network Lab	100	0	100	E	1

Third Semester

Course Code	Name of Course	Internal Marks	Univ. Marks	Total Marks	C/E	Credits
CWT3301	Project evaluation & Viva voce	100	200	300	C	18

Fourth Semester

Course Code	Name of Course	Internal Marks	Univ. Marks	Total Marks	C/E	Credits
CWT3401	Project evaluation & Viva voce	100	200	300	C	18

CWT3101 Probability and Stochastic Processes

Module I

Probability spaces. Random variables and random vectors. Distributions and densities. Statistical independence. Expectations, moments and characteristic functions. Infinite sequences of random variables. Convergence concepts. Laws of large numbers.

Module II

Stochastic processes. Separability and measurability. Continuity concepts. Gaussian processes and Wiener processes. Second order processes. Covariance functions and their properties. Linear operations and second order calculus. Orthogonal expansions.

Module III

Stationary in the strict and wide senses. Ergodicity in the q.m.sense. Widesense stationary processes. Herglotz's and Bochner's theorems. Spectral presentation. L2 – stochastic integrals. Spectral decomposition theorem. Low-pass and band-pass processes. White noise and white-noise integrals.

Module IV

Spectrum Estimation - Non-Parametric Methods-Correlation Method – Co-Variance Estimator – Performance Analysis of Estimators – Unbiased, Consistent Estimators – Periodogram Estimator – Barlett Spectrum Estimation – Welch Estimation – Model based Approach – AR> MA, ARMA Signal Modeling – Parameter Estimation using Yule-Walker Method.

Module V

Linear Estimation and Prediction - Maximum likelihood criterion-efficiency estimator – Least mean squared error criterion – Wiener filter – Discrete Wiener Hoff equations – Recursive estimators-Kalman filter – Linear Production, prediction error-whitening filter, inverse filter – Levinson recursion. Lattice realization, and Levinson recursion algorithm for soling Teoplitz system of equations.

Text Books:

1. A.Papoulis, S.U.Pillai, "Proabability, Random variables and Stochastic processes" 4th edition Tata-Mc Hill (4/e) ,2001
2. R.B.Ash & C.Doleans-Dade, Probability and Measure Theory (2/e), Elsevier, 2005
3. Monson H. Hayes, Statistical Digital Signal Processing and Modelling, John Wiley and Sons, Inc., New York, 1996

Reference Books:

1. E.Wong & B.Hajek, Stochastic Processes in Engineering systems, Springer, 1985
2. R.B.Ash & W.A.Gardner, Topics in stochastic processes, Academic Press, 1975.
3. Stakgold, I., Green's Functions and Boundary value Problems (e), Wiley,1998
4. Sopocles J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1990
5. John G Proakis, Dimitris G Manolais, Digital Signal Processing Prentice Hall of India, 1995

CWT3102 WIRELESS COMMUNICATIONS

Module I

Radio Propagation: Free space propagation model, Relating power to electric field, reflection, ground reflection diffraction, scattering, practical link budget design using path loss models, outdoor propagation models, indoor propagation models, signal penetration into buildings, ray tracking and site specific modeling, small scale multi-path propagation, impulse response model of a multi-path channel, small scale multi-path measurements, parameters of mobile multi-path channels, types of small scale fading, Rayleigh and Ricean distributions, statistical models for multi-path fading channels.

Module II

Diversity Techniques: Concepts of Diversity branch and signal paths, Combining and switching methods, C/N, C/I performance improvements, Average P_e, performance improvement, RAKE receiver.

Module III

Cellular Concept: Frequency reuse, channel assignment strategies, handoff strategies; interference and system capacity, trunking and grade of service, improving coverage and capacity in cellular systems. FDMA, TDMA, spread spectrum multiple access, SDMA, packet Radio, capacity of cellular systems.

Module IV

Personal Mobile Satellite Communications: PCN**,** Integration of GEO, LEO, and MEO Satellite and Terrestrial mobile systems, personal satellite Communications programs. Multiple Input Multiple Output (MIMO) Wireless communications. Software Defined Radio (SDR). Characteristics and benefits of a Software Radio, Design Principles of Software Radio, Enhanced Flexibility with receiver design challenges.

Module V

CDMA Systems Implementation: Is-95 System Architecture, Soft Handoff and Power Control in IS-95 CDMA, cdma2000 System. **Signal reception:** Wireless signaling environment, basic receiver signal processing for wireless, blind multi-user detection, linear receivers for synchronous CDMA, blind multi-user detection direct methods, blind multi-user detection subspace methods, performance of blind multi-user detector, subspace tracking algorithms, blind multi-user detector in multi-path channels.

Reference Books:

1. Theodore S. Rappaport, "**Wireless Communications: Principles and Practice**", 2nd edition, Prentice Hall of India, 2005.
2. Kamilo Feher, "**Wireless Digital Communications: Modulation and Spread Spectrum Techniques**", Prentice Hall of India, 2004.
3. V K Garg and J E Wilkes, "Wireless and Personal Communication Systems", Prentice Hall, 1996.
4. Vijay K. Garg, "**IS-95 CDMA and cdma2000**," Pearson Education (Asia) Pte. Ltd, 2004.

5. Xiaodong Wang and Vincent Poor, "**Wireless Communication Systems: Advanced Techniques for Signal Reception**", Pearson Education (Asia) Pte. Ltd, 2004
6. **Wireless Communication Technology** by Roy Blake
7. S Haykin and M Moher, "Modern Wireless Communication", Pearson Education, 2005.
8. Jeffrey H Reed, " Software Radio: A Modern Approach to Radio Engineering", Prentice Hall, May 2002.
9. C Oestges and B Clerckx, "MIMO Wireless Communications", 1st Edition 2007.
10. A J Viterbi, "CDMA: Principles of Spread Spectrum Communications", Addison Wisley, Newyork, 1995.

CWT3103 ANTENNA SYSTEMS

Module I

Antenna Fundamentals

Antenna fundamental parameters,. Radiation integrals ,Radiation from surface and line current distributions – dipole, monopole, loop antenna; Mobile phone antenna- base station, hand set antenna; Image; Induction ,reciprocity theorem, Broadband antennas and matching techniques, Balance to unbalance transformer, Introduction to numerical techniques

Module II

Radiation from Apertures
Field equivalence principle, Radiation from Rectangular and Circular apertures, Uniform aperture distribution on an infinite ground plane; Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration.

Module III

Array Antenna
Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Two dimensional uniform array; Phased array, beam scanning, grating lobe, feed network,; Linear array synthesis techniques – Binomial and Chebyshev distributions.

Module IV

Micro Strip Antenna
Radiation Mechanism from patch; Excitation techniques; Microstrip dipole; Rectangular patch, Circular patch, and Ring antenna – radiation analysis from cavity model; input impedance of rectangular and circular patch antenna; Microstrip array and feed network; Application of microstrip array antenna.

Module V

Emc Antenna And Antenna Measurements
Concept of EMC measuring antenna; Rx and Tx antenna factors; Log periodic dipole, Bi-conical, Ridge guide, Multi turn loop; Antenna measurement and instrumentation – Gain, Impedance and antenna factor measurement; Antenna test range Design.

References:

1. Balanis.A, “Antenna Theory Analysis and Design”, John Wiley and Sons, New York, 1982.
2. Krauss.J.D, “Antennas”, II edition, John Wiley and sons, New York, 1997.
3. I.J. Bahl and P. Bhartia,” Microstrip Antennas”,Artech House,Inc.,1980
   W.L.Stutzman and G.A.Thiele,”Antenna Theory and Design”, 2nd edition,John Wiley& Sons Inc.,1998.
4. R E Collin, “Antennas and Radiowave Propagation” McGraw Hill, 1985.
5. R C Johnson an H Jasik, “Antenna Engineering Handbook”, McGraw Hill, 1989.
6. I J Bahal and PBharatia, “Microstrip Antennas”, Artech House, 1980.

CWT3104 Digital Communication

Module I

Digital Modulation Techniques: QPSK, DPSK, FQPSK, QAM, M-QAM, OFDM, Optimum Receiver for Signals Corrupted by AWGN, Performance of the Optimum Receiver for Memory-less Modulation, Optimum Receiver for CPM Signals, Optimum Receiver for Signals with Random Phase in AWGN Channel.

Module II

Coding Techniques: Convolutional Codes, Hamming Distance Measures for Convolutional Codes; Various Good Codes, Maximum Likelihood Decoding of Convolutional codes, Error Probability with Maximum Likelihood Decoding of Convolutional Codes, Sequential Decoding and Feedback Decoding, Trellis Coding with Expanded Signal Sets for Band-limited Channels, Viterbi decoding.

Module III

Communication through band limited linear filter channels: Optimum receiver for channels with ISI and AWGN, Linear equalization, Decision-feedback equalization, reduced complexity ML detectors, Iterative equalization and decoding-Turbo equalization.

Module IV

Adaptive equalization: Adaptive linear equalizer, adaptive decision feedback equalizer, adaptive equalization of Trellis- coded signals, Recursive least squares algorithms for adaptive equalization, self recovering (blind) equalization.

Module V

Digital Communication through fading multi-path channels: Characterization of fading multi-path channels, the effect of signal characteristics on the choice of a channel model, frequency-Nonselective, slowly fading channel, diversity techniques for fading multi-path channels, Digital signal over a frequency-selective, slowly fading channel, coded wave forms for fading channels, multiple antenna systems.

Reference Books:

1. "Fundamentals of Digital communication", Cambridge University Press, 2008.
2. John G. Proakis, "**Digital Communications"**," 4th edition, McGraw Hill, 2006.
3. Stephen G. Wilson, "**Digital Modulation and Coding"**, Pearson Education (Asia) Pte. Ltd, 2003.
4. Kamilo Feher," **Wireless Digital Communications: Modulation and Spread Spectrum Applications'"**" Prentice-Hall of India, 2004.
5. John G. Proakis, "**Digital Communications"**," 4th edition, McGraw Hill, 2001.
6. Andrew J. Viterbi, "**CDMA: Principles of Spread Spectrum Communications",** Prentice Hall, USA, 1995.

CWT3105 Network routing algorithms

Module I

Introduction

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, General Classification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

Module II

Internet Routing

Interior protocol : Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast Routing: Pros and cons of Multicast and Multiple Unicast Routing, Distance Vector Multicast Routing Protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core Based Tree Routing**.**

Module III

Routing In Optical Wdm Networks

Classification of RWA algorithms, RWA algorithms, Fairness and Admission Control, Distributed Control Protocols, Permanent Routing and Wavelength Requirements, Wavelength Rerouting- Benefits and Issues, Lightpath Migration, Rerouting Schemes, Algorithms- AG, MWPG.

Module IV

Mobile - Ip Networks

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based : Hierarchical Mobile IP, Intra domain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure (HAWAII).

Module V

Mobile Ad –Hoc Networks

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced Distance Vector Routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).

References:

1. William Stallings, ' High speed networks and Internets Performance and Quality of Service', IInd Edition, Pearson Education Asia. Reprint India 2002
2. M. Steen Strub, ' Routing in Communication network, Prentice –Hall International, Newyork,1995.
3. S. Keshav, 'An engineering approach to computer networking' Addison Wesley 1999.
4. William Stallings, 'High speed Networks TCP/IP and ATM Design Principles, Prentice-Hall, New York, 1995
5. C.E Perkins, 'Ad Hoc Networking', Addison – Wesley, 2001
6. Ian F. Akyildiz, Jiang Xie and Shantidev Mohanty, " A Survey of mobility Management in Next generation All IP- Based Wireless Systems", IEEE Wireless Communications Aug.2004, pp 16-27.
7. A.T Campbell et al., " Comparison of IP Micromobility Protocols," IEEE Wireless Communications Feb.2002, pp 72-82.

CWT3106 Optical & Wire line Technology

Module I

Fibre Optic Guides, Light wave generation systems, systems components, optical fibers, SI, GI fibre, modes, Dispersion in fibers limitations due to dispersions, fibre loss, non liner effects.

Module II

Optical Transmitters and Fibres, Basic concepts, LED structures spectral distribution, semiconductor lasers, gain coefficients, modes, SIM and SIM operation. Transmitter design, Receive PIN and APD diodes design noise sensitivity degradation Light Wave System Coherent, homodyne and Hetro dyne keying formats, BER in synchronous and Asynchronous.

Module III

Amplifiers, Basic concepts, Semiconductor laser amplifiers Raman and Brillouin-fibre amplifiers, Erbium doped-fibre and amplifiers, pumping phenomenon Dispersion Compensation Limitations, post and pre-compensation techniques, equalizing filters,SONET/SDH.

Module IV

Analogue fixed line, broadband cable access, cabling, DTMF, ISDN, Numbering & addressing Broadband ISDN. Protocol reference model. ATM standard. Multistage networks. Traffic models; delay and loss performance. Cell switching. Cell scale and burst scale queuing.

Module V

Wire line Narrowband, XDSL, Wire line broad band, grid and cloud compacting, Very High Bit Rate Digital Subscriber Line (VDSL), Power Line Telecommunication (PLT) – Access, Power Line Telecommunication (PLT) – Home Networks, PLT & VDSL Transmission Protocols, VDSL & Access PLT Topology

Text Books:

1. J.F.Kurose & K.W. Ross, Computer Networking,(3/e), Pearson Education,2005
2. A.Pattavina, Switching Theory, Wiley, 1998.
3. Franze & Jain, Optical communication, systems and components, Narosa Publication, New Delhi, 2000
4. G Keiser, Optical fibre communication, system, McGraw Hill, Newyork, 2000

Reference Books:

1. S.Basagni, Mobile Ad Hoc Networking, Wiley,2004.
2. J.M.Pitts & J.A.Schormans, Introduction to IP and ATM Design and Performance (2/e), Wiley, 2000.
3. C.Siva Ram Murthy & B.S.Manoj, Adhoc Wireless Networks (2/e), Pearson Education, 2005
4. Jean warland and Pravin Varaiya, High, Performance communication Networks, 2nd Edition, Harcourt and Morgan Kauffman, London, 2000
5. G. P. Agarwal, Fibre optic communication system, 2nd Edition, John Wiley & b sons, New York 1997
6. Franz and Jain, Optical communication system, Narosa Publications, New Delhi, 1995

CWT3107 MEMS

Module I

RF MEMS relays and switches. Switch parameters. Actuation mechanisms. Bistable relays and micro actuators. Dynamics of switching operation.

Module II

MEMS inductors and capacitors. Micromachined inductor. Effect of inductor layout. Modeling and design issues of planar inductor. Gap tuning and area tuning capacitors. Dielectric tunable capacitors.

Module III

Micromachined RF filters. Modeling of mechanical filters. Electrostatic comb drive. Micromechanical filters using comb drives. Electrostatic coupled beam structures.

Module IV

MEMS phase shifters. Types. Limitations. Switched delay lines. Micromachined transmission lines. Coplanar lines. Micromachined directional coupler and mixer.

Module V

Micromachined antennas. Microstrip antennas – design parameters. Micromachining to improve performance. Reconfigurable antennas.

Text Books:

1. H.J.D.Santos, RF MEMS Circuit Design for Wireless Communications, Artech House ,2002.
2. G.M.Rebeiz , RF MEMS Theory , Design and Technology, wiley , 2003.
3. Stephen D Senturia, “Microsystem Design”, Kluwer Academic Publishers, 2001.
4. Marc Madou, “Fundamentals of Microfabrication”, CRC Press, 1997.

Reference Book:

1. V.K.Varadan etal, RF MEMS and their Applications, Wiley,2003.
2. Gregory Kovacs, “Micromechanised Transducers Source Book”, WCB McGraw Hill, Boston, 1998.
3. M H Bao, “Micromechanical Transducers, Pressure Sensors, Accelerometers and Gyroscopes” Elsevier, Newyork, 2000.

CWT3201 Cellular Mobile Communication

Module I

Introduction To Wireless Mobile Communications

History and evolution of mobile radio systems.Types of mobile wireless services/systems-Cellular,WLL,Paging,Satelite systems,Standards,Future trends in personal wireless systems

Module II

Cellular Concept And System Design Fundamentals

Cellular concept and frequency reuse, Multiple Access Schemes, channel assignment and handoff, Interference and system capacity, Trunking and Erlang capacity calculations. Frequency plans: Channelized Schemes and Frequency Hopping

Module III

Mobile Radio Propagation

Radio wave propagation issues in personal wireless systems, Propagation models, Multipath fading and Base band impulse respond models, parameters of mobile multipath channels,Antenna systems in mobile radio. Mobile Radio Interference : Co-Channel and Adjacent Channel Interference, Intermodulation, IntersymbolInterference.

Module IV

Modulation And Signal Processing

Analog and digital modulation techniques,Performance of various modulation techniques-Spectral efficiency,Error-rate,Power Amplification,Equalizing Rake reciever concepts,Diversity and space-time processing,Speech coding and channel coding. Spread Spectrum.

Module V

System Examples And Design Issues

Multiple Access Techniques-FDMA, TDMA and CDMA systems, operational systems, Wireless networking, design issues in personal wireless systems, 2G,2.5G, 3G, 4G, LTE.

References:

1. K.Feher,Wireless digital communications,PHI,New Delhi,1995
2. T.S.Rappaport,Wireless digital communications;Principles and practice,Prentice Hall,NJ,1996.
3. W.C.Y.Lee,Mobile communications Engineering:Theory And Applications,Second Edition,
   McGraw Hill,New York.19908.
4. Schiller,Mobile Communications;Pearson Education Asia Ltd.,2000.
5. R Steele and L Manzo, “Mobile Radio communications”, John Wiley, 1992, 2nd Edition.
6. G H Stubber, “Principles of Mobile Communications”, Kluwer, 1996.

CWT3202 Electromagnetic Interference/ Electromagnetic Compatibility (EMI/EMC) in System

Module I

Emi/Emc Concepts

EMI-EMC definitions and Units of parameters; Sources and victim of EMI; Conducted and Radiated EMI Emission and Susceptibility; Transient EMI, ESD; Radiation Hazards.

Module II

Emi Coupling Principles

Conducted, radiated and transient coupling; Common ground impedance coupling ; Common mode and ground loop coupling ; Differential mode coupling ; Near field cable to cable coupling, cross talk ; Field to cable coupling ; Power mains and Power supply coupling.

Module III

Emi Control Techniques

Shielding, Filtering, Grounding, Bonding, Isolation transformer, Transient suppressors, Cable routing, Signal control.

Module IV

Emc Design Of Pcbs

Component selection and mounting; PCB trace impedance; Routing; Cross talk control; Power distribution decoupling; Zoning; Grounding; VIAs connection; Terminations.

Module V

Emi Measurements And Standards

Open area test site; TEM cell; EMI test shielded chamber and shielded ferrite lined anechoic chamber; Tx /Rx Antennas, Sensors, Injectors / Couplers, and coupling factors; EMI Rx and spectrum analyzer; Civilian standards-CISPR, FCC, IEC, EN; Military standards-MIL461E/462.

References:

1. V.P.Kodali, “Engineering EMC Principles, Measurements and Technologies”, IEEE Press, Newyork, 1996.
2. Henry W.Ott.,”Noise Reduction Techniques in Electronic Systems”, A Wiley Inter Science Publications, John Wiley and Sons, Newyork, 1988.
3. Bemhard Keiser, “Principles of Electromagnetic Compatibility”, 3rd Ed, Artech house, Norwood, 1986.
4. C.R.Paul,”Introduction to Electromagnetic Compatibility” , John Wiley and Sons, Inc, 1992.
5. Don R.J.White Consultant Incorporate, “Handbook of EMI/EMC” , Vol I-V, 1988.

CWT3203 Ad Hoc & Sensor Networks

Module I

Mobile ad hoc networking; imperatives, challenges and characteristics. Bluetooth networks. Routing approaches. Proactive and reactive protocols. Clustering and hierarchial routing. Multipath routing. Security aware routing.

Module II

Energy efficient communication in ad hoc networks. Measuring energy consumption. Power save protocols. Maximum life time routing. Secure routing protocols. Intrusion detection. Security considerations in ad hoc sensor networks. Key management.

Module III

The Sensor Network Concept. Introduction, Applications. Deployment & Configuration, Localization and calibration, Coverage and connectivity

Module IV

Data Gathering-Tree construction algorithms and an Asymptotic capacity,Lifetime optimization formulations, Routing and Querying-- Publish/Subscribe mechanisms - Geographic routing- Robustness - Storage and retrieval

Module V

Collaborative Signal Processing and Distributed Computation- Detection, estimation, classification problems- Energy-efficient distributed algorithms, Security- Privacy issues- Attacks and countermeasures

Text Books:

1. S.Basagni & M.Conti, Mobile Ad Hoc Networking, Wiley, 2004
2. C.Perkins, Ad Hoc Networking, Addison Wesley, 2000.

Reference Books:

1. C.S. Murthy & B.S. Manoj, AdHoc Wireless Networks, Pearson, 2004.
2. T.Janevski, Traffic Analysis and Design of Wireless IP Networks, Artech House, 2003.
3. Ozan K. Tonguz & Gianluigi, Adhoc Wireless Networks, Wiley, 2006

CWT3204 Smart Antennas

Module I

Introduction To Smart Antennas

Need for Smart Antennas, Smart Antenna Configurations, Switched-Beam Antennas, Adaptive Antenna Approach, Space Division Multiple Access (SDMA), Architecture of a Smart Antenna System, Receiver, Transmitter, Benefits and Drawbacks, Mutual Coupling Effects

Module II

DOA Estimation Fundamentals

Introduction The Array Response Vector, Received Signal Model, The Subspace-Based Data Model, Signal Autocovariance Matrices ,Conventional DOA Estimation Methods, Conventional Beamforming Method, Capon's Minimum Variance Method, Subspace Approach to DOA Estimation ,The MUSIC Algorithm, The ESPRIT Algorithm, Uniqueness of DOA Estimates

Module III

Beamforming Fundamentals

The Classical Beamformer-Statistically Optimum BeamformingWeight Vectors, The Maximum SNR Beamformer, The Multiple Sidelobe Canceller and the Maximum, SINR Beamformer- Minimum Mean Square Error (MMSE),Direct Matrix Inversion (DMI), Linearly Constrained Minimum Variance (LCMV) , Adaptive Algorithms for Beamforming ,The Least Mean-Square (LMS) Algorithm, The Recursive Least-Squares (RLS) Algorithm

Module IV

Space–Time Processing

Introduction, Discrete Space–Time Channel and Signal Models, Space–Time Beamforming, Intersymbol and Co-Channel Suppression, ISI Suppression, CCI Suppression, Joint ISI and CCI Suppression, Space–Time Processing for DS-CDMA, Capacity and Data Rates in MIMO Systems, Single-User Data Rate Limits, Multiple-Users Data Rate Limits, Data Rate Limits Within a Cellular System, MIMO in Wireless Local Area Networks

Module V

Mobile Stations' Smart Antennas-

Introduction -Multiple-Antenna MS Design, Combining Techniques, Selection (Switched) Diversity, Maximal Ratio Combining, Adaptive Beamforming or Optimum Combining ,RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements ,Downlink Capacity Gains

Text Books:

1. Constantine A. Balanis, Panayiotis I. Ioannides, Introduction to Smart Antennas Morgan & Claypool Publishers
2. Ahmed El Zooghby, Smart Antenna Engineering, Artech House

Reference Book:

1. M.J. Bronzel, Smart Antennas, John Wiley, 2004
2. T.S.Rappaport & J.C.Liberti, Smart Antennas for Wireless Communication, Prentice Hall (PTR) , 1999.
3. R.Janaswamy, Radio Wave Propagation and Smart Antennas for Wireless Communication, Kluwer, 2001

CWT3205 Global Positioning Systems

Module I

History of GPS – BC-4 System – HIRAN – NNSS – NAVSTAR GLONASS and GNSS Systems – GPS Constellation – Space Segment – Control Segment – User Segment – Single and Dual Frequency – Point – Relative – Differential GPS – Static and Kinematic Positioning – 2D and 3D – reporting Anti Spoofing (AS); Selective Availability (SA) – DOP Factors.

Module II

Coordinate Systems – Geo Centric Coordinate System – Conventional Terrestrial Reference System – Orbit Description – Keplerian Orbit – Kepler Elements – Satellite Visibility – Topocentric Motion – Disturbed Satellite Motion – Perturbed Motion – Disturbing Accelerations - Perturbed Orbit – Time Systems – Astronomical Time System – Atomic Time – GPS Time – Need for Coordination – Link to Earth Rotation – Time and Earth Motion Services.

Module III

C/A code; P-code; Y-code; L1, L2 Carrier frequencies – Code Pseudo Ranges – Carries Phases – Pseudo Ranges – Satellite Signal Signature – Navigation Messages and Formats – Undifferenced and Differenced Range Models – Delta Ranges – Signal Processing and Processing Techniques – Tracking Networks – Ephemerides – Data Combination: Narrow Lane; Wide Lane – OTF Ambiguity.

Module IV

Propagation Media – Multipath – Antenna Phase Centre – Atmosphere in brief – Elements of Wave Propagation – Ionospheric Effects on GPS Observations – Code Delay – Phase Advances – Integer Bias – Clock Error – Cycle Slip – Noise-Bias – Blunders – Tropospheric Effects on GPS Oberservables – Multipath Effect – Antenna Phase Centre Problems and Correction.

Module V

Inter Disciplinary Applications – Crystal Dynamics – Gravity Field Mapping – Atmospheric Occulation – Surveying – Geophysics – Air borne GPS – Ground Transportation – Space borne GPS – Metrological and Climate Research using GPS.

References:

1. B.Hoffman - Wellenhof, H.Lichtenegger and J.Collins, "GPS: Theory and Practice", 4th revised edition, Springer, Wein, New york,1997
2. A.Leick, "GPS Satellites Surveying", 2nd edition, John Wiley & Sons,NewYork,1995
3. B.Parkinson, J.Spilker, Jr.(Eds), "GPS: Theory and Applications", Vol.I & Vol.II, AIAA, 370 L'Enfant Promenade SW, Washington, DC 20024, 1996
4. A.Kleusberg and P.Teunisen(Eds), “GPS for Geodesy”, Springer-Verlag, Berlin,1996
5. L.Adams, "The GPS - A Shared National Asset”, Chair, National Academy Press, Washington, DC, 1995

CWT3206 Image And Video Processing

Module I

Image Sampling and Quantization: Introduction, 2D sampling theory, Limitations in sampling & reconstruction, Quantization, Optimal quantizer, Compander, Visual quantization.

Image Transforms: Introduction, 2D orthogonal & unitary transforms, Properties of unitary transforms, DFT, DCT, DST, Hadamard, Haar, Slant, KLT, SVD transform.

Module II

Image Representation by Stochastic Models: Introduction, one-dimensional Causal models, AR models, Non-causal representations, linear prediction in two dimensions. Image Enhancement: Point operations, Histogram modeling, spatial operations, Transform operations, Multi-spectral image enhancement, false color and Pseudo-color, Color Image enhancement.

Module III

Image Filtering & Restoration: Image observation models, Inverse & Wiener filtering, Fourier Domain filters, Smoothing splines and interpolation, Least squares filters, generalized inverse, SVD and Iterative methods, Maximum entropy restoration, Bayesian methods, Coordinate transformation & geometric correction, Blind de-convolution.

Module IV

Image Reconstruction from Projections: Introduction, Radon Transform, Back projection operator, Projection theorem, Inverse Radon transform, Fourier reconstruction, Fan beam reconstruction, 3D tomography**.** Image Data Compression: Introduction, Pixel coding, Predictive techniques, Transform coding, Inter-frame coding, coding of two tone images, Image compression standards.

Module V

Video Processing: Fundamental Concepts in Video – Types of video signals, Analog video, Digital video, Color models in video, Video Compression Techniques – Motion compensation, Search for motion vectors, H.261, H.263, MPEG I, MPEG 2, MPEG 4, MPEG 7 and beyond, Content based video indexing.

Text Book:

1. K. Jain**,** "**Fundamentals of Digital Image Processing"**, Pearson Education (Asia) Pte. Ltd./Prentice Hall of India, 2004.

Reference Books:

1**.** Z. Li and M.S. Drew**,** "**Fundamentals of Multimedia"**, Pearson Education (Asia) Pte. Ltd., 2004.

2. R. C. Gonzalez and R. E. Woods, "**Digital Image Processing"**, 2nd edition, Pearson Education (Asia) Pte. Ltd/Prentice Hall of India, 2004.

3. M. Tekalp, "**Digital Video Processing"**, Prentice Hall, USA, 1995.

CWT3207 Broadband Wireless Technologies

Module I
Transmission Fundamentals-Analog and Digital communication, channel capacity, switching techniques, asynchronous transfer mode, the TCP/IP Protocol Architecture, The OSI model, Internetworking.

Module II
Mobile radio propagation, fading, diversity techniques, design parameters at the base station, smart antenna systems, Practical link budget design using path loss models

Module III
CDMA- Principle, Network design, Link capacity, Power control, RAKE receiver, Channel modeling. WCDMA-Network planning, MC-CDMA, Orthogonal frequency division multiplexing, OFDM with code division

Module IV
Wireless networks-wireless local loop(WLL) and LMDS,Wireless local area networks(WLANs),IEEE 802.11Architecture & services,MAC,physical layer,IEEE 802.11a,802.11b standards,HIPERLAN,Bluetooth and PANs,Zigbee technology,WiMAX.

Module V
TDMA standards, cellular networks, 2G, evolution of 2.5G, cellular mobile communication beyond 3G,4G,IS -136 GPRS,UMTS

Text Books:

1. S.G. Glisic, Adaptive CDMA, Wiley, 2003
2. A.F.Molisch, Wireless Communications, Wiley, 2005.

Reference Books:

1. K.Fazel & S. Kaiser, Multi-carrier and Spread Spectrum Systems, Wiley, 2003
2. S.G. Glisic, Advanced Wireless Communications, 4G Technologies, Wiley, 2004.
3. W.C.Y.Lee, Mobile Communication Engineering. (2/e), McGraw- Hill,1998
4. Wireless Communication Technology by Roy Blake