**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M.TECH IN COMMUNICATION SYSTEMS**

**EFFECTIVE FROM ACADEMIC YEAR 2017- 18 ADMITTED BATCH**
**COURSE STRUCTURE AND SYLLABUS**

**I Semester**

| Category | Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|---|
| PC-1 | Spread Spectrum Communications | 25 | 75 | 4 | 0 | 0 | 4 |
| PC-2 | Wireless Communications and Networks | 25 | 75 | 4 | 0 | 0 | 4 |
| PC-3 | Advanced Data Communications | 25 | 75 | 4 | 0 | 0 | 4 |
| PE-1 | Detection and Estimation Theory<br>Advanced Digital Signal Processing<br>Radio Navigational Aids | 25 | 75 | 3 | 0 | 0 | 3 |
| PE-2 | TCP/IP Internetworking<br>Cognitive Radio Networks<br>Radar Systems Engineering | 25 | 75 | 3 | 0 | 0 | 3 |
| OE-1 | ***Open Elective – I** | 25 | 75 | 3 | 0 | 0 | 3 |
| Laboratory I | Advanced Data Communications Lab | 25 | 75 | 0 | 0 | 3 | 2 |
| Seminar I | Seminar | 100 | 0 | 0 | 0 | 3 | 2 |
| **Total** | | **275** | **525** | **21** | **0** | **6** | **25** |

**II Semester**

| Category | Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|---|
| PC-4 | Coding Theory and Techniques | 25 | 75 | 4 | 0 | 1 | 4 |
| PC-5 | Advanced Communications and Networks | 25 | 75 | 4 | 0 | 1 | 4 |
| PC-6 | 3G Networks | 25 | 75 | 4 | 0 | 1 | 4 |
| PE-3 | Wireless LANs and PANs<br>Wireless MIMO Communications<br>Ad-hoc Wireless Networks | 25 | 75 | **3** | 0 | 0 | 3 |
| PE4 | Network Security And Cryptography<br>Optical Communications and Networks<br>Multimedia and signal coding | 25 | 75 | **3** | 0 | 0 | 3 |
| OE-2 | ***Open Elective – II** | 25 | 75 | 3 | 0 | 0 | 3 |
| Laboratory II | Advanced Communications and Networks Lab | 25 | 75 | 0 | 0 | 3 | 2 |
| Seminar II | Seminar | 100 | 0 | 0 | 0 | 3 | 2 |
| **Total** | | **275** | **525** | **21** | **0** | **6** | **25** |

**III Semester**

| Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|
| Technical Paper Writing | 100 | 0 | 0 | 3 | 0 | 2 |
| Comprehensive Viva-Voce | 0 | 100 | 0 | 0 | 0 | 4 |
| Project work Review I | 100 | 0 | 0 | 0 | 22 | 8 |
| **Total** | **200** | **100** | 0 | **3** | 22 | **14** |

**IV Semester**

| Course Title | Int. marks | Ext. marks | L | T | P | C |
|---|---|---|---|---|---|---|
| Project work Review II | 100 | 0 | 0 | 0 | 24 | 8 |
| Project Evaluation (Viva-Voce) | 0 | 200 | 0 | 0 | 0 | 16 |
| **Total** | **100** | **200** | **0** | **0** | **24** | **24** |

***Open Elective subjects must be chosen from the list of open electives offered by various departments.**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**SPREAD SPECTRUM COMMUNICATION (PC-1)**

**UNIT -I**

**Introduction to Spread Spectrum Systems:** Fundamental Concepts of Spread Spectrum Systems, Pseudo Noise Sequences, Direct Sequence Spread Spectrum, Frequency Hop Spread Spectrum, Hybrid Direct Sequence Frequency Hop Spread Spectrum, Code Division Multiple Access.

**Binary Shift Register Sequences for Spread Spectrum Systems:**
Introduction, Definitions, Mathematical Background and Sequence Generator Fundamentals, Maximal Length Sequences, Gold Codes.

**UNIT -II**

**Code Tracking Loops:** Introduction, Optimum Tracking of Wideband Signals, Base Band Delay-Lock Tracking Loop, Tau-Dither Non- Coherent Tracking Loop, Double Dither Non-Coherent Tracking Loop.

**UNIT -III**

**Initial Synchronization of the Receiver Spreading Code:** Introduction, Problem Definition and the Optimum Synchronizer, Serial Search Synchronization Techniques, Synchronization using a Matched Filter, Synchronization by Estimated the Received Spreading Code.

**UNIT -IV**

**Cellular Code Division Multiple Access (CDMA) Principles:** Introduction, Wide Band Mobile Channel, The Cellular CDMA System, Single User Receiver in a Multi User Channel, CDMA System Capacity,

**Multi-User Detection in CDMA Cellular Radio:** Optimal Multi-User Detection, Linear Suboptimal Detectors, Interference Combat Detection Schemes, Interference Cancellation Techniques.

**UNIT -V**

**Performance of Spread Spectrum Systems in Jamming Environments:** Spread Spectrum Communication System Model, Performance of Spread Spectrum Systems without Coding.

**Performance of Spread Spectrum Systems with Forward Error Correction:** Elementary Block Coding Concepts, Optimum Decoding Rule, Calculation of Error Probability, Elementary Convolution Coding Concepts, Viterbi Algorithm, Decoding and Bit-Error Rate.

**TEXT BOOKS:**


1. Rodger E Ziemer, Roger L. Peterson and David E Borth, “Introduction to Spread Spectrum Communication”- Pearson Education, 1st Edition, 1995.
2. Mosa Ali Abu-Rgheff, “Introduction to CDMA Wireless Communications.” Elsevier Publications, 2008.


**REFERENCE BOOKS:**


1. George R. Cooper, Clare D. Mc Gillem, “Modern Communication and Spread Spectrum”, McGraw Hill, 1986.
2. Andrew j. Viterbi, “CDMA: Principles of spread spectrum communication”, Pearson Education, 1st Edition, 1995.
3. Kamilo Feher, “Wireless Digital Communications”, PHI, 2009.
4. Andrew Richardson, “WCDMA Design Handbook”, Cambridge University Press, 2005.
5. Steve Lee, “Spread Spectrum CDMA”, McGraw Hill, 2002.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**WIRELESS COMMUNICATIONS AND NETWORKS (PC-2)**

**UNIT -I**

**The Cellular Concept-System Design Fundamentals:** Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies- Prioritizing Handoffs, Practical Handoff Considerations, Interference and system capacity – Co channel Interference and system capacity, Channel planning for Wireless Systems, Adjacent Channel interference , Power Control for Reducing interference, Trunking and Grade of Service, Improving Coverage & Capacity in Cellular Systems- Cell Splitting, Sectoring .

**UNIT –II**

**Mobile Radio Propagation: Large-Scale Path Loss:** Introduction to Radio Wave Propagation, Free Space Propagation Model, Relating Power to Electric Field, The Three Basic Propagation Mechanisms, Reflection-Reflection from Dielectrics, Brewster Angle, Reflection from prefect conductors, Ground Reflection (Two-Ray) Model, Diffraction-Fresnel Zone Geometry, Knife-edge Diffraction Model, Multiple knife-edge Diffraction, Scattering, Outdoor Propagation Models- Longley-Ryce Model, Okumura Model, Hata Model, PCS Extension to Hata Model, Walfisch and Bertoni Model, Wideband PCS Microcell Model, Indoor Propagation Models-Partition losses (Same Floor), Partition losses between Floors, Log-distance path loss model, Ericsson Multiple Breakpoint Model, Attenuation Factor Model, Signal penetration into buildings, Ray Tracing and Site Specific Modeling.

**UNIT –III**

**Mobile Radio Propagation: Small –Scale Fading and Multipath:** Small Scale Multipath propagation-Factors influencing small scale fading, Doppler shift, Impulse Response Model of a multipath channel- Relationship between Bandwidth and Received power, Small-Scale Multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding Correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile Multipath Channels-Time Dispersion Parameters, Coherence Bandwidth, Doppler Spread and Coherence Time, Types of Small-Scale Fading-Fading effects Due to Multipath Time Delay Spread, Flat fading, Frequency selective fading, Fading effects Due to Doppler Spread-Fast fading, slow fading, Statistical Models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler spread in Clarke's model, Simulation of Clarke and Gans Fading Model, Level crossing and fading statistics, Two-ray Rayleigh Fading Model.

**UNIT -IV**

**Equalization and Diversity:** Introduction, Fundamentals of Equalization, Training A Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Non linear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization-Zero Forcing Algorithm, Least Mean Square Algorithm, Recursive least squares algorithm. Diversity Techniques-Derivation of selection Diversity improvement, Derivation of Maximal Ratio Combining improvement, Practical Space Diversity Consideration-Selection Diversity, Feedback or Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

**UNIT -V**

**Wireless Networks:** Introduction to wireless Networks, Advantages and disadvantages of Wireless Local Area Networks, WLAN Topologies, WLAN Standard IEEE 802.11,IEEE 802.11 Medium Access

Control, Comparision of IEEE 802.11 a,b,g and n standards, IEEE 802.16 and its enhancements, Wireless PANs, Hiper Lan, WLL.

**TEXT BOOKS:**


1. Theodore, S. Rappaport, "Wireless Communications, Principle, Practice ", 2nd Edition, 2002, PHI.
1. Andrea Goldsmith, "Wireless Communications", 2005 Cambridge University Press.
2. Kaveh Pah Laven and P. Krishna Murthy, "Principles of Wireless Networks", 2002, PE
3. Gottapu Sasibhushana Rao, "Mobile Cellular Communication", Pearson Education, 2012.


**REFERENCE BOOKS:**


1. Kamilo Feher, "Wireless Digital Communications", 1999, PHI.
2. William Stallings, "Wireless Communication and Networking", 2003, PHI.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**ADVANCED DATA COMMUNICATIONS (PC-3)**

**UNIT- I**

Data Communications, Networks and Network Types, Internet History, Standards and Administration, Protocol Layering, TCP/IP protocol suite, OSI Model. Digital Data Transmission, DTE-DCE interface.

**Data Link Layer**

Introduction, Data Link Layer, Nodes and Links, Services, Categories of Links, sub layers, Link Layer Addressing, Address Resolution Protocol.

**UNIT- II**

**Error Detection and Correction**: Types of Errors, Redundancy, detection versus correction, Coding Block Coding: Error Detection, Vertical redundancy cheeks, longitudinal redundancy cheeks, Error Correction, Error correction single bit, Hamming code.

**Cyclic Codes**: Cyclic Redundancy Check, Polynomials, Cyclic Code Encoder Using Polynomials, Cyclic Code Analysis, Advantage of Cyclic Codes, Checksum

**Data Link Control**: DLC Services, Data Link Layer Protocols, HDLC, Point to Point Protocol

**UNIT- III**

**Switching:** Introduction to Switching, Circuit Switched Networks, Packet Switching, Structure of switch

**Multiplexing:** Multiplexing, Frequency Division Multiplexing, Time Division Multiplexing.

**Connecting devices:** Passive Hubs, Repeaters, Active Hubs, Bridges, Two Layer Switches, Routers, Three Layer Switches, Gateway, Back bone Networks.

**Wired LANS:** Ethernet Protocol, Standard Ethernet, Fast Ethernet, Gigabit Ethernet, 10 Giga bit Ethernet

**UNIT- IV**

**Media Access Control (MAC) Sub Layer:** Random Access, ALOHA, Carrier Sense Multiple Access (CSMA), Carrier Sense Multiple Access with Collision Detection (CSMA/CD), Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA),Controlled Access- Reservation, Polling- Token Passing, Channelization - Frequency Division Multiple Access (FDMA), Time - Division Multiple Access (TDMA), Code - Division Multiple Access (CDMA).

**Spectrum Spreading:** Spread Spectrum-Frequency Hopping Spread Spectrum and Direct Sequence Spread Spectrum.

**UNIT- V**

**Networks Layer:** Packetizing, Routing and Forwarding, Packet Switching, Network Layer Performance, IPv4 Address, Address Space, Classful Addressing, Classless Addressing, Dynamic Host Configuration Protocol (DHCP), Network Address Resolution(NATF), Forwarding of IP Packets, Forwarding based on Destination Address, Forwarding based on Label, Routing as Packet Switches.

**Unicast Routing** : Introduction, Routing Algorithms-Distance Vector Routing, Link State Routing, Path Vector Routing, Unicast Routing Protocols- Routing Information Protocol(RIP), Open Short Path First Version 4.

**TEXT BOOKS:**

1. B. A. Forouzan," Data Communications and Networking", 5th Edition, 2013, TMH.

2. William Stallings, “Data and Computer Communications”, 8th Edition, 2007, PHI.

**REFERENCE BOOKS:**

1. Prakash C. Gupta, “Data Communications and Computer Networks”, 2006, PHI.
2. B. A. Forouzan,” Data Communications and Networking”, 2nd Edition, 2013, TMH.
3. Brijendra Singh, “Data Communications and Computer Networks”, 2nd Edition, 2005, PHI.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**DETECTION AND ESTIMATION THEORY (**PE-1)

**UNIT I**

**Random Processes:** Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

**UNIT II**

**Detection Theory:** Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

**UNIT –III**

**Linear Minimum Mean-Square Error Filtering:** Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters.

**UNIT –IV**

**Statistics:** Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

**UNIT –V**

**Estimating the Parameters of Random Processes from Data:** Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

**TEXT BOOKS:**


1. K. Sam Shanmugan & A.M. Breipohl, “Random Signals: Detection, Estimation and Data Analysis”, Wiley India Pvt. Ltd, 2011.
2. Lonnie C. Ludeman, “Random Processes: Filtering, Estimation and Detection”, Wiley India Pvt. Ltd., 2010.


**REFERENCE BOOKS:**


1. Steven.M.Kay, “Fundamentals of Statistical Signal Processing: Volume I Estimation Theory”, Prentice Hall, USA, 1998.
2. Steven.M.Kay, “Fundamentals of Statistical Signal Processing: Volume I Detection Theory”, Prentice Hall, USA, 1998.
3. Srinath, Rajasekaran, Viswanathan, “Introduction to Statistical Signal Processing with Applications”, 2003, PHI.
4. Louis L.Scharf, “Statistical Signal Processing: Detection, Estimation and Time Series Analysis”, 1991, Addison Wesley.
5. Harry L. Van Trees, “Detection, Estimation and Modulation Theory: Part – I”, 2001, John Wiley & Sons, USA.
6. Mischa Schwartz, Leonard Shaw, “Signal Processing: Discrete Spectral Analysis – Detection & Estimation”, 1975, Mc Graw Hill.

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**ADVANCED DIGITAL SIGNAL PROCESSING (**PE-1)

**UNIT –I**

**Review of DFT, FFT, IIR Filters and FIR Filters:** Introduction to filter structures (IIR & FIR). Implementation of Digital Filters, specifically 2nd Order Narrow Band Filter and 1st Order All Pass Filter. Frequency sampling structures of FIR, Lattice structures, Forward prediction error, Back ward prediction error, Reflection coefficients for lattice realization, Implementation of lattice structures for IIR filters, Advantages of lattice structures.

**UNIT -II**

**Non-Parametric Methods:** Estimation of spectra from finite duration observation of signals, Non-parametric Methods: Bartlett, Welch & Blackman-Tukey methods, Comparison of all Non-Parametric methods

**UNIT - III**

**Parametric Methods:** Autocorrelation & Its Properties, Relation between auto correlation & model parameters, AR Models - Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation, Finite word length effect in IIR digital Filters – Finite word-length effects in FFT algorithms.

**UNIT –IV**

**Multi Rate Signal Processing:** Introduction, Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a rational factor I/D, Multistage Implementation of Sampling Rate Conversion, Filter design & Implementation for sampling rate conversion. Examples of up-sampling using an All Pass Filter.

**UNIT –V**

**Applications of Multi Rate Signal Processing:** Design of Phase Shifters, Interfacing of Digital Systems with Different Sampling Rates, Implementation of Narrow Band Low Pass Filters, Implementation of Digital Filter Banks, Subband Coding of Speech Signals, Quadrature Mirror Filters, Transmultiplexers, Over Sampling A/D and D/A Conversion.

**TEXT BOOKS:**


1. J.G.Proakis & D. G. Manolakis, “Digital Signal Processing: Principles, Algorithms & Applications”, 4th Edition, PHI.
2. Alan V Oppenheim & Ronald W Schaffer, “Discrete Time signal processing “, PHI.
3. Emmanuel C. Ifeacher, Barrie. W. Jervis, “DSP – A Practical Approach”, 2nd Edition, Pearson Education.


**REFERENCE BOOKS:**


1. S. M .Kay, “Modern spectral Estimation: Theory & Application “, 1988, PHI.
2. P.P.Vaidyanathan, “Multi Rate Systems and Filter Banks”, Pearson Education.
3. Kaluri V. Rangarao, Ranjan K. Mallik, “Digital Signal Processing: A Practitioner's Approach”, ISBN: 978-0-470-01769-2, 210 pages, November 2006 John Weley.
4. S.Salivahanan, A.Vallavaraj, C.Gnanapriya, “Digital Signal Processing”, 2000,TMH

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**RADIO NAVIGATIONAL AIDS (**PE-1)

**UNIT –I**

**Navigational Systems:** Review of Navigational Systems: Aircraft navigational system. Geometry of the earth. Navigation equation. Navigation errors. Radio navigation system types and Performance parameters. ILS System, Hyperbolic navigation systems, Loran, Omega, Decca Radio direction finding, DME. TACAN and VORTAC.

**UNIT –II**

**Inertial Navigation:** Inertial navigation system. Sensing instruments: Accelerometer. Gyro- copes, Analytic and Gimbaled platforms. Mechanization. Error analysis, Alignment.

**UNIT –III**

**Global Positioning System (GPS) for Navigation:** Overview of GPS, Reference systems. Satellite orbits, Signal structure, Geometric dilution of precision (GDOP), or Precision dilution of recision (PDOP), Satellite ephemeris, Satellite clock, Ionospheric group delay. Tropospheric group delay, Multipath errors and Receiver measurement errors.

**UNIT –IV**

**Differential GPS and WAAS:** Standard and precise positioning service local area DGPS and Wide area DGPS errors. Wide Area Augmentation System (WAAS) architecture. Link budget and Data Capacity, Ranging function, Precision approach and error estimates.

**UNIT –V**

**GPS Navigational Application:** General applications of GPS, DGPS, Marine. Air and Land Navigation, Surveying, Mapping and Geographical information systems, Military and Space.

**TEXT BOOKS:**


1. Myron Kavton and Walter Friend R., “Avionics Navigation Systems”, Wiley,1997
2. Parkinson. BW. Spilker “Global Positioning System Theory and Applications”, Progress in Astronautics, Vol. I and II, 1996.


**REFERENCE BOOKS:**


1. Hoffman. B., Wellenhof. H. Lichtenegger and J. Collins, “GPS Theory and Practice”, Springer Verlang Wien, New York, 1992.
2. Elliot D. Kaplan, “Understanding GPS Principles and Applications”, Artech House. Inc., 1996.
3. Lieck Alfred, “GPS Satellite Surveying”, John Wiley, 1990.

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**TCP/IP INTERNETWORKING (**PE-2)

**UNIT - I**

**Network Models:** Layered Tasks, The OSI Model, Layers in OSI Model, TCP/IP Protocol suite, Addressing.

**Connecting devices:** Passive Hubs, Repeaters, Active Hubs, Bridges, Two Layer Switches, Routers, Three Layer Switches, Gateway, Backbone Networks.

**UNIT -II**

**Internetworking Concepts:** Principles of Internetworking, Connectionless Interconnection, Application Level Interconnection, Network Level Interconnection, Properties of the Internet, Internet Architecture, Interconnection through IP Routers

**TCP, UDP & IP:** TCP Services, TCP Features, Segment, A TCP Connection, Flow Control, Error Control, Congestion Control, Process to Process Communication, User Datagram, Checksum, UDP Operation, IP Datagram, Fragmentation, Options, IP Addressing: Classful Addressing, IPV6.

**UNIT -III**

**Congestion and Quality of Service:** Data Traffic, Congestion, Congestion Control, Congestion Control in TCP, Congestion Control in Frame Relay, Source Based Congestion Avoidance, DEC Bit Scheme, Quality of Service, Techniques to Improve QOS: Scheduling, Traffic Shaping, Admission Control, Resource Reservation, Integrated Services and Differentiated Services.

**UNIT - IV**

**Queue Management:** Concepts of Buffer Management, Drop Tail, Drop Front, Random Drop, Passive Buffer Management Schemes, Drawbacks of PQM, Active Queue Management: Early Random Drop, RED Algorithm.

**UNIT - V**

**Stream Control Transmission Protocol:** SCTP Services, SCTP Features, Packet Format, Flow Control, Error Control, Congestion Control.

**Mobile Network Layer:** Entities and Terminology, IP Packet Delivery, Agents, Addressing, Agent Discovery, Registration, Tunneling and Encapsulating, Inefficiency in Mobile IP.

**Mobile Transport Layer :** Classical TCP Improvements, Indirect TCP, Snooping TCP, Mobile TCP, Fast Retransmit/Fast Recovery, Transmission, Timeout Freezing, Selective Retransmission, Transaction Oriented TCP.

**TEXT BOOKS:**


1. Behrouz A Forouzan, “TCP/IP Protocol Suite”, TMH, 3rd Edition
2. B.A. Forouzan, “Data communication & Networking”, TMH, 4th Edition.


**REFERENCES:**


1. Mahbub Hasan & Raj Jain, ” High performance TCP/IP Networking”, PHI -2005
2. Douglas. E.Comer, “Internetworking with TCP/IP “, Volume I PHI
3. Larry L. Perterson and Bruce S.Davie , “Computer Networks- A Systems Approach”, 2011, Morgan Kaufmann
4. Jochen Schiiler, “Mobile Communications” , Pearson , 2nd Edition.

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**COGNITIVE RADIO NETWORKS (**PE-2)

**UNIT – I**

**Wireless Communications**: Wireless Communication Systems, Orthogonal Frequency Division Multiplexing (OFDM), MIMO, Multiuser Detection (MUD).

**Software Defined Radio:** Software Defined Radio Architecture, Digital Signal Processor, SDR Baseband Architecture. Reconfigurable Wireless communication Systems, Digital Radio Processing.

**Concept of Cognitive Radio:** Cognitive Radio Bands, Spectrum policy, Application of Cognitive radio, Cognitive radio network design, spectrum coexistence in Cognitive radio network

**UNIT – II**

**Wireless Networks:** Multiple Access Communications and ALOHA,, Splitting Algorithms, Carrier Sensing, Routing, Flow Control.

**Cooperative Communications and Networks:** Information Theory for Cooperative Communications, Cooperative Communications, Cooperative Wireless Networks.

**Cognitive Radio Communications:** Cognitive Radios and Dynamic Spectrum Access, Analytical Approach and Algorithms for Dynamic Spectrum Access, Fundamental Limits of Cognitive Radios, Mathematical Models toward Networking Cognitive Radios.

**UNIT – III**

**Cognitive Radio Networks:** Network Coding for Cognitive Radio Relay Networks, Cognitive Radio Networks Architecture, Terminal Architecture of CRN, QoS Provisional Diversity Radio Access Networks, Scaling Laws of Ad Hoc and Cognitive Radio Networks.

**Spectrum Sensing:** Spectrum Sensing to Detect Specific Primary System, Spectrum Sensing for Cognitive OFDMA Systems, Spectrum Sensing for Cognitive Multi-Radio Networks.

**UNIT – IV**

**Medium Access Control:** MAC for cognitive Radios, Multi-channel MAC, Slotted-ALOHA with Rate-Distance Adaptability, CSMA with AMC.

**Network Layer Design:** Routing in Mobile Ad Hoc Networks, Routing in Cognitive Radio Networks, Control of CRN, Network tomography, Self-Organization in Mobile Communication Networks.

**UNIT – V**

**Trusted Cognitive Radio Networks:** Framework of Trust in CRN, Trusted Association and Routing, Trust with Learning, Security in CRN.

**Spectrum Management of Cognitive Radio Networks:** Spectrum Sharing, Spectrum Pricing, Mobility Management of Heterogeneous Wireless Networks, Regulatory Issues and International Standards.

**TEXT BOOKS:**


1. Kwang-Cheng Chen, Ramjee Prasad, “Cognitive Radio Networks”, Wiley , 2009
2. Ezio Biglieri, Andrea J. Goldsmith, Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor, “Principles of Cognitive Radio”, Cambridge, 2012

**REFERENCES:**


1. Ekram Hossain, Dusit Niyato, Zhu Han, “Dynamic Spectrum Access and Management in Cognitive Radio Networks”, Cambridge, 2009
2. Linda E. Doyle,” Essentials of Cognitive Radio”, Cambridge, 2009

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**RADAR SYSTEMS ENGINEERING (PE-2)**

**UNIT -I**

**Radar Range Equation:** Radar fundamentals, Derivation of range equation, the search radar equation, Jamming and radar range with jamming, Radar clutter and radar range with clutter, Radar range with combined interferences sources.

**UNIT -II**

**Theory of Target Detection:** Noise and false alarms, Detection of one sample of signal with noise, Integration of pulse trains, Detection of fluctuating targets, CFAR, Optimum and matched filter Theory, Loss factors in detection.

**UNIT -III**

**Targets and Interference:** Definition of radar cross section, Radar cross section of simple and complex objects, Spatial distribution of cross section, Bistatic cross section, CW and FM Radar: Doppler Effect, CW and FMCW Radar, Airborne Doppler Navigation, Multi frequency CW Radar.

**UNIT -IV**

**MTI Radar:** Delay lines and line cancellors, Subclutter Visibility. MTI using range gates and filters, Pulse Doppler radar, Non-coherent MTI radar, Application of Digital signal processing to radar system.

**Tracking Radar:** Different types of tracking techniques, Tracking in range, Tracking in Doppler, Search Acquisition radar, Comparison of Trackers.

**UNIT -V**

**Introduction to Pulse Compression Radar:** Height finding radars, Air traffic control Radars and data handling, Atmospheric effects of radar, Electromagnetic compatibility aspects, Airborne Radars, Synthetic Aperture Radar, Secondary surveillance Radars.

**TEXT BOOKS:**


1. David Barton .K ," Modern Radar System Analysis", Artech House, 1988.
2. Fred Nathanson E, "Radar Design Principles Signal Processing and The Environment", Mc Graw Hill, 1969.


**REFERENCE BOOKS:**


1. Cook CE. Bernfield. M," Radar Signals", Academic Press, 1967.
2. Skolnik , " Introduction to radar systems", Mc Graw Hill, 2nd Edition, 2003.

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**M. TECH. I YEAR I SEMESTER**
**COMMUNICATION SYSTEMS**

**ADVANCED DATA COMMUNICATIONS LAB (Laboratory I)**

**Note:**

A. Minimum of 10 Experiments to be conducted
B. All Experiments may be Simulated using MATLAB (or any equivalent software) and to be verified using related training kits.

1. Determination of output of convolution Encoder for a given sequence
2. Determination of output of convolution Decoder for a given sequence
3. Efficiency of DS Spread- Spectrum Technique
4. Simulation of Frequency Hopping (FH) Spread- Spectrum
5. Optimum receiver for the AWGN channel.
6. Measurement of effect of Inter Symbol Interference..
7. Simulation of PSK system with M=4
8. Simulation of DPSK system with M=4
9. Design of FSK system
10. BPSK Modulation and Demodulation techniques
11. QPSK Modulation and Demodulation techniques
12. DQPSK Modulation and Demodulation techniques
13. 8-QAM Modulation and Demodulation techniques
14. OFDM Transceiver design
15. Performance evaluation of simulated CDMA system
16. Implementation of QPSK Modulation with Rayleigh Fading and AWGN channel