NATIONAL INSTITUTE OF TECHNOLOGY NAGALAND
CHUMUKEDIMA, DIMAPUR – 797 103

M.Tech Degree Programme
Curriculum

Regulations 2016

Master of Technology in Communication Engineering

Semester I

Course Code	Course Title	L	T	P	C
MA501	Applied Mathematics	3	1	0	4
CM501	Advanced Digital Communication Techniques	3	0	0	3
CM502	Information and Coding Theory	3	0	0	3
CM503	Communication Networks and Protocols	3	0	0	3
CM504	Wireless Communication	3	0	0	3
CM913	Elective-I	3	0	0	3
CM506	Communication System Simulation Laboratory	0	0	4	3
TOTAL		**18**	**1**	**4**	**22**

MA501 APPLIED MATHEMATICS **L T P C**
3 1 0 4

LINEAR ALGEBRA **12**

Vector spaces – norms – Inner Products – Eigen values using QR transformations – QR factorization - generalized eigenvectors – Canonical forms – singular value decomposition and applications - pseudo inverse – least square approximations -- Toeplitz matrices and some applications.

LINEAR PROGRAMMING **12**

Formulation – Graphical solution – Simplex method – Two phase method - Transportation and Assignment Models.

ORDINARY DIFFERENTIAL EQUATIONS **12**

Runge Kutta Methods for system of IVPs, numerical stability, Adams-Bashforth multistep methop, solution of stiff ODEs, shooting method, BVP: Finite difference method, orthogonal collocation method, orthogonal collocation with finite element method, Galerkin finite element method.

TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve – Correlation**.**

QUEUEING MODELS **12**

Poisson Process – Markovian queues – Single and Multi-server Models – Little's formula - Machine Interference Model – Steady State analysis – Self Service queue.

TOTAL:45+15:60 PERIODS

REFERENCES:

1. Richard Bronson, Gabriel B.Costa, "Linear Algebra", Academic Press, Second Edition, 2007.

2. Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).

3. Taha H.A., “Operations Research: An introduction”, Pearson Education Asia, New Delhi, Ninth Edition, 2012.

4. Donald Gross and Carl M. Harris, “Fundamentals of Queueing Theory”, 2nd edition, John Wiley and Sons, New York (1985).

5. Moon, T.K., Sterling, W.C., Mathematical methods and algorithms for signal processing,Pearson Education, 2000.

CM 501 ADVANCED DIGITAL COMMUNICATION TECHNIQUES

L T P C
3 0 0 3

COHERENT AND NON-COHERENT COMMUNICATION 9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – Noncoherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK--BER Performance Analysis. Carrier Synchronization- Bit synchronization.

EQUALIZATION TECHNIQUES 9

Band Limited Channels- ISI – Nyquist Criterion- Controlled ISI-Partial Response signals-Equalization algorithms – Viterbi Algorithm – Linear equalizer – Decision feedbackequalization – Adaptive Equalization algorithms.

BLOCK CODED DIGITAL COMMUNICATION 9

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Transorthogonal – Shannon’s channel coding theorem; Channel capacity; Matched filter; Concepts of Spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hammning; Golay; Cyclic; BCH ; Reed – Solomon codes - Space time block codes.

CONVOLUTIONAL CODED DIGITAL COMMUNICATION 9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo Coding.

OFDM **9**

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension; Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes-Clipping, Filtering, Coding and Scrambling.

REFERENCES:

1. M.K.Simon, S.M.Hinedi and W.C.Lindsey, Digital communication techniques; Signalling and detection, Prentice Hall India, New Delhi. 1995.

2. Simon Haykin, Digital communications, John Wiley and sons, 1998.

3. Bernard Sklar., 'Digital Communications', second edition, Pearson Education,2001.

4. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.

5. Theodore S.Rappaport., 'Wireless Communications', 2nd edition, Pearson Education, 2002.

6. Stephen G. Wilson., 'Digital Modulation and Coding', First Indian Reprint ,Pearson Education, 2003.

7. Richard Van Nee & Ramjee Prasad., 'OFDM for Multimedia Communications' Artech House Publication,2001.

CM 502 INFORMATION THEORY AND CODING **L T P C**
3 0 0 3

QUANTITATIVE STUDY OF INFORMATION **9**

Basic inequalities, Entropy, Kullback-Leibler distance, Mutual information, Bounds on entropy, Fisher information , Cramer Rao inequality, Second law of thermodynamics,Sufficient statistic, Entropy rates of a Stochastic process.

CAPACITY OF NOISELESS CHANNEL **9**

Fundamental theorem for a noiseless channel, Data compression, Kraft inequality, Shannon-Fano codes , Huffman codes , Asymptotic equipartition, Rate distortion theory.

CHANNEL CAPACITY **9**

Properties of channel capacity, Jointly typical sequences, Channel Coding Theorem, converse to channel coding theorem, Joint source channel coding theorem.

DIFFERENTIAL ENTROPY AND GAUSSIAN CHANNEL 9

AEP for continuous random variables, relationship between continuous and discrete entropy, properties of differential entropy, Gaussian channel definitions, converse to coding theorem for Gaussian channel, channels with colored noise, Gaussian channels with feedback.

CHANNEL CODING TECHNIQUES
9

Galois Fields, Fundamental Theorem of Galois Theory (FTGT), Reed-Solomon Codes, Turbo Codes, LDPC Codes, TCM.

TOTAL: 45 PERIODS

REFERENCES:

1. Thomas Cover, Joy Thomas, "Elements of Information Theory ", Wiley, 2005.

2. David Mackay , "Information Theory, Interference & Learning Algorithms", Cambridge University Press, 1st edition, 2002.

CM 503 COMMUNICATION NETWORKS AND PROTOCOLS L T P C
3 0 0 3

INTRODUCTION
7

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of Network layer, GeneralClassification of routing, Routing in telephone networks, Dynamic Non hierarchical Routing.

INTERNET ROUTING 10

Interior protocol : Routing Information Protocol.

ROUTING IN OPTICAL WDM NETWORKS 10

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.

MOBILE - IP NETWORKS 9

Macro-mobility Protocols, Micro-mobility protocol: Tunnel based : Hierarchical

Mobile IP, Intradomain Mobility Management, Routing based: Cellular IP, Handoff Wireless Access Internet Infrastructure.

MOBILE AD – HOC NETWORKS **9**

Internet-based mobile ad-hoc networking communication strategies, Routing algorithms –
Proactive routing: destination sequenced Distance Vector Routing.

TOTAL: 45 PERIODS

REFERENCES:

1. William Stallings, ‘ High speed networks and Internets Performance and Quality of Service’, IIEdition, 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 Nextgeneration All IP- Based Wireless Systems”, IEEE Wireless Communications Aug.2004, pp 1627.

7. A.T Campbell et al., “Comparison of IP Micromobility Protocols,” IEEE Wireless Communications Feb.2002, pp 72-82.

8. C.Siva Rama Murthy and Mohan Gurusamy, “ WDM Optical Networks – Concepts, Design andAlgorithms”, Prentice Hall of India Pvt. Ltd, New Delhi –2002.

CM504 WIRELESS COMMUNICATION **L T P C**
3 0 0 3

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WIRELESS CHANNEL PROPAGATION AND MODEL **9**

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-Small scale fading- channel classification- channel models – COST -231

Hata model, Longley-Rice Model, NLOS Multipath Fading Models: Rayleigh, Rician, Nakagami, Composite Fading –shadowing Distributions, Link power budget Analysis.

DIVERSITY **9**

Capacity of flat and frequency selective fading channels-Realization of independent fading paths, Receiver Diversity: selection combining, Threshold Combining, Maximum-ratio Combining, Equal gain Combining. Transmitter Diversity: Channel known at transmitter, channel unknown at the transmitter.

MIMO COMMUNICATIONS **9**

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity Gain:Beamforming, Diversity-Multiplexing trade-offs, Space time Modulation and coding : STBC,STTC, Spacial Multiplexing and BLAST Architectures.

MULTI USER SYSTEMS **9**

Multiple Access : FDMA,TDMA, CDMA,SDMA, Hybrid techniques, Random Access: ALOHA,SALOHA,CSMA, Scheduling, power control, uplink downlink channel capacity, multiuser diversity, MIMO-MU systems.

WIRELESS NETWORKS **9**

3G Overview, Migration path to UMTS, UMTS Basics, Air Interface, 3GPP Network Architecture, 4G features and challenges, Technology path, IMS Architecture - Introduction to wireless LANs -IEEE 802.11 WLANs - Physical Layer- MAC sublayer.

TOTAL: 45 PERIODS

REFERENCES:

1. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2007.

2. HARRY R. ANDERSON, “Fixed Broadband Wireless System Design” John Wiley – India, 2003.

3. Andreas.F. Molisch, “Wireless Communications”, John Wiley – India, 2006.

4. Simon Haykin & Michael Moher, “Modern Wireless Communications”, Pearson Education, 2007.

5. Rappaport. T.S., “Wireless communications”, Pearson Education, 2003.

6. Clint Smith. P.E., and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill,2007.

7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers,http://books.elsevier.com/9780123735805:, 2007.

8. Kaveth Pahlavan,. K. Prashanth Krishnamuorthy, "Principles of Wireless Networks", Prentice Hall of India, 2006.

9. William Stallings, "Wireless Communications and networks" Pearson / Prentice Hall of India, 2nd Ed., 2007.

10. Sumit Kasera and Nishit Narang, “3G Networks – Architecture, Protocols and Procedures”, Tata McGraw Hill, 2007.

CM506 COMMUNICATION SYSTEM LABORATORY **L T P C**
0 0 3 2

List of Experiments Use Network Analyser for the following experiments:

1. Measurement of transmission line parameters.
2. S-parameter estimation of Microwave devices.
3. Design and testing of a Microstrip coupler.
4. Characteristics of λ/4 and λ/2 transmission lines.

Use appropriate simulation tools for the following experiments:

1. Channel equalizer design (LMS, RLS)
2. Antenna Radiation Pattern measurement.
3. Performance Evaluation of digital modulation schemes
4. OFDM transceiver design
5. Simulation of Microstrip Antennas
6. Performance evaluation of simulated CDMA System.

TOTAL : 45 PERIODS

Semester II

Course Code	Course Title	L	T	P	C
CM551	Detection and Estimation Theory	3	0	0	3
CM552	Advanced Signal Processing	3	0	0	3
CM553	Radio Frequency Integrated Circuits and Systems	3	1	0	4
CM9XX	Elective – II(FPGA Based System Design)	3	0	0	3
CM915	Elective-III (Speech Processing and Coding)	3	0	0	3
CM908	Elective – IV (WSN/Mobile Communication)	3	0	0	3
CM554	Communication System Design Laboratory	0	0	3	2
TOTAL		**18**	**1**	**3**	**21**

CM551 DETECTION AND ESTIMATION THEORY **L T P C**
3 0 0 3

DISCRETE RANDOM SIGNAL PROCESSING 9

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Auto covariance, Autocorrelation, Parseval's theorem, Wiener-Khintchine relation, White noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.

SPECTRAL ESTIMATION 9

Estimation of spectra from finite duration signals, Nonparametric methods – Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods –ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.

DETECTION AND ESTIMATION CRITERIA 9

Detection criteria : Bayes detection techniques, MAP, ML,– detection of M-ary signals, Neyman Peason, minimax decision criteria. Estimation: linear estimators, non-linear estimators, Bayes, MAP,ML, properties of estimators, phase and amplitude estimation.

SYNCHRONIZATION 9

Signal parameter estimation, carrier phase estimation, symbol timing estimator, joint estimation of carrier phase and symbol timing.

RECEIVERS FOR AWGN AND FADING CHANNELS 9

Optimum receivers for AWGN channel -Correlation demodulator, matched filter, maximum likelihood sequence detector, envelope detectors for M-ary signals; Characterization of fading multipath channels, RAKE demodulator, Multiuser detection techniques.

TOTAL: 45 PERIODS

REFERENCES:

1. Monson H. Hayes, 'Statistical Digital Signal Processing and Modeling", John Wiley and Sons, Inc, Singapore, 2002

2. John J. Proakis, Dimitris G. Manolakis, : Digital Signal Processing', Pearson Education, 2002.

3. John G. Proakis., 'Digital Communication', 4 th edition, Mc Graw Hill Publication, 2001.

4. Bernard Sklar and Pabitra Kumar Roy, Digital Communications: Fundamentals & Applications, 2/E, Pearson Education India, 2009

5. John G. Proakis, Masoud Salehi, "Communication Systems Engineering", Prentice Hall, 1994.

CM552 ADVANCED DIGITAL SIGNAL PROCESSING L T P C
3 0 0 3

DISCRETE RANDOM SIGNAL PROCESSING 9

Weiner Khitchine relation - Power spectral density – filtering random process, Spectral Factorization Theorem, special types of random process – Signal modeling- Least Squares method, Pade approximation, Prony's method, iterative Prefiltering, Finite Data records, Stochastic Models.

SPECTRUM ESTIMATION 9

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.

LINEAR ESTIMATION AND PREDICTION 9

Maximum likelihood criterion - Efficiency of estimator - Least mean squared error criterion Wienerfilter - Discrete Wiener Hoff equations - Recursive estimators - Kalman filter – Linear prediction, Prediction error - Whitening filter, Inverse filter - Levinson recursion, Lattice realization,Levinson recursion algorithm for solving Toeplitz system of equations.

ADAPTIVE FILTERS 9

FIR Adaptive filters - Newton's steepest descent method - Adaptive filters based on steepest descent method - Widrow Hoff LMS Adaptive algorithm - Adaptive channel equalization – Adaptive echo canceller - Adaptive noise cancellation - RLS Adaptive filters - Exponentially weighted RLS Sliding window RLS - Simplified IIR LMS Adaptive filter.

MULTIRATE DIGITAL SIGNAL PROCESSING 9

Mathematical description of change of sampling rate - Interpolation and Decimation – Continuous time model - Direct digital domain approach - Decimation by integer factor - Interpolation by an integer factor - Single and multistage realization - Poly phase realization - Applications to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

TOTAL: 45 PERIODS

REFERENCES:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, 2006.

2. Sophoncles J. Orfanidis, "Optimum Signal Processing ", McGraw-Hill, 2000. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Prentice Hall of India, NewDelhi, 2005.

3. Simon Haykin, "Adaptive Filter Theory", Prentice Hall, Englehood Cliffs, NJ1986.

4. S. Kay," Modern spectrum Estimation theory and application", Prentice Hall, Englehood Cliffs,NJ1988.

5. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1992.

CM553 RADIO FREQUENCY INTEGRATED CIRCUITS AND SYSTEMS

L	T	P	C
3	0	0	3

RF ISSUES **9**

Importance of RF design- Electromagnetic spectrum, RF behavior of passive components, chip components and circuit board considerations, scattering parameters, smith chart and applications.

RF FILTER DESIGN **9**

Overview, Basic resonator and filter configuration, special filter realizations, smith chart based filter design, coupled filter.

ACTIVE RF COMPONENTS AND APPLICATIONS **9**

RF diodes, BJT, RF FET'S, High electron mobility transistors, matching and biasing networksimpedance matching using discrete components, microstripline matching networks, amplifier classesof operation and biasing networks.

RF AMPLIFIER DESIGNS **9**

Characteristics, amplifier power relations, stability considerations, constant gain circles, constant VSWR circles, low noise circles broadband, high power and multistage amplifiers.

OSCILLATORS, MIXERS & APPLICATIONS **9**

Basic oscillator model, High Frequency oscillator configuration, basic characteristic of mixers, wireless synthesizers, phase locked loops, detector and demodulator circuits.

TOTAL: 45PERIODS

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, RF Circuit Design – Theory and Applications, Pearson Education Asia, First Edition, 2001.

2. Joseph. J. Carr, Secrets of RF Circuit Design , McGraw Hill Publishers, Third Edition, 2000.

3. Mathew M. Radmanesh, Radio Frequency & Microwave Electronics, Pearson Education Asia, Second Edition, 2002.

4. Ulrich L. Rohde and David P. NewKirk, RF / Microwave Circuit Design, John Wiley & Sons USA 2000.

5. Roland E. Best, Phase - Locked Loops: Design, simulation and applications, McGraw Hill Publishers 5TH edition 2003.

VL906 SPEECH SIGNAL PROCESSING AND CODING

L T P C
3 0 0 3

SPEECH PRODUCTION

9

Physiological and Mathematical Model, Relating the Physiological and Mathematical Model, Categorization of Speech Sounds - Source-System Model, Articulatory Model.

SPEECH SIGNAL PROCESSING

9

Discrete Time Speech Signals, Fast Fourier Transform and Z-Transform, Convolution,

Linear and Non Linear Filter Banks, Spectral Estimation, Pole-Zero Modeling of Speech, Linear Prediction (LP) Analysis of Speech, Real and Complex Cepstrum, Application of Cepstral Analysis.

SPEECH RECOGNITION

9

Feature Extraction- Static and Dynamic Features for Speech Recognition, Robustness Issues, Discrimination in the Feature Space, Feature Selection, Mel Frequency Cepstral Co-efficients (MFCC), Linear Prediction Cepstral Coefficients (LPCC), and Perceptual LPCC. Distance Measures for Comparing Speech Patterns- Log Spectral Distance, Cepstral Distances, Weighted Cepstral Distances, Distances for Linear and Warped Scales.

SPEECH RECOGNITION MODEL

9

Dynamic Time Warping for Isolated Word Recognition, Statistical Models for Speech Recognition, Vector Quantization Models for Speaker Recognition, Gaussian Mixture Modeling for Speaker and Speech Recognition, Discrete and Continuous Hidden Markov Modeling for Isolated Word and Continuous Speech Recognition, HTK tool.

SPEECH CODING

9

Speech Apparatus, Models of Vocal Tract, Speech Coding using Linear Prediction, CELP Coder, Waveform Coding, Vocoders, Vocoders Attributes.

Total: 45 periods

TEXT BOOKS

1. Digital Processing of Speech Signals, L. R. Rabiner and R. W. Schafer, Pearson Education.
2. Discrete-Time Speech Signal Processing: Principles and Practice, Thomas F. Quatieri,
Cloth, ISBN: 013242942X Published: OCT 29, 2001.
3. Fundamentals of Speech Recognition, L. Rabiner and B. Juang, Prentice-Hall Signal
Processing Series, Year of Publication: 1993, ISBN:0-13-015157-2.

REFERENCE BOOKS

1. Discrete Time Processing of Speech Signals, JR Deller, JG Proakis, JH Hansen, Year
of Publication: 1993, ISBN:0023283017.
2. Hidden Markov Models for Speech Recognition, XD Huang, Y Ariki, MA Jack, Edinburgh University Press.

VL956 FPGA BASED SYSTEM DESIGN

L T P C

3 0 0 3

MULTIRATE SIGNAL PROCESSING 9

Decimation and Interpolation. Spectrum of decimated and interpolated signals,

Polyphase decomposition of FIR filters and its applications to multirate DSP. Sampling rate converters, Sub-band encoder.

FILTER BANKS

9

Uniform filter bank. direct and DFT approaches. Introduction to ADSL Modem. Discrete multitone modulation and its realization using DFT. QMF. Short time Fourier Transform Computation of DWT using filter banks. Implementation and verification on FPGAs.

CORDIC

9

DDFS- ROM LUT approach. Spurious signals, jitter. Computation of special functions using CORDIC. Vector and rotation mode of CORDIC. CORDIC architectures. Implementation and verification on FPGAs.

SOFTWARE RADIO

9

Block diagram of a software radio. Digital downconverters and demodulators. Universal modulator and demodulator using CORDIC. Incoherent demodulation - digital approach for I and Q generation, special sampling schemes. CIC filters. Residue number system and high speed filters using RNS. Down conversion using discrete Hilbert transform. Undersampling receivers, Coherent demodulation schemes.

SPEECH CODING 9

Speech apparatus. Models of vocal tract. Speech coding using linear prediction. CELP coder. An overview of waveform coding. Vocoders. Vocoder attributes. Block diagrams of encoders and decoders of G723.1, G726, G727, G728 and G729.

Total: 45 Period

TEXT BOOKS

1. J. H. Reed, “Software Radio”, Pearson, 2002.

2. U. Meyer – Baese , “Digital Signal Processing with FPGAs”, Springer, 2004

REFERENCE BOOKS

1. Tsui, “Digital Techniques for Wideband receivers”, Artech House, 2001.

2. S. K. Mitra, “Digital Signal processing”, McGrawHill, 1998

CM601 SOFTWARE DEFINED RADIO SYSTEMS **L T P C**

3 0 0 3

INTRODUCTION TO SDR **9**

Definitions and potential benefits, software radio architecture evolution – foundations, technology tradeoffs and architecture implications, Antenna for Cognitive Radio.

SDR ARCHITECTURE **9**

Essential functions of the software radio, architecture goals, quantifying degrees of programmability, top level component topology, computational properties of functional components, interface topologies among plug and play modules, architecture partitions.

INTRODUCTION TO COGNITIVE RADIOS **9**

Marking radio self-aware, the cognition cycle, organization of congnition tasks, structuring knowledge for cognition tasks, Enabling location and environment awareness in cognitive radios –concepts, architecture, design considerations.

COGNITIVE RADIO ARCHITECTURE 9

Primary Cognitive Radio functions, Behaviors, Components, A–Priori Knowledge taxonomy, observe – phase data structures, Radio procedure knowledge encapsulation, components of orient, plan, decide phases, act phase knowledge representation, design rules.

NEXT GENERATION WIRELESS NETWORKS 9

The XG Network architecture, spectrum sensing, spectrum management, spectrum mobility, spectrum sharing, upper layer issues, cross – layer design.

TOTAL: 45 PERIODS

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee, And Y. Thomas Hou, " Cognitive Radio Communications And Networks - Principles And Practice", Elsevier Inc. , 2010.

2. "E. Biglieri, A.J. Goldsmith., L.J. Greenstein, N.B. Mandayam, H.V. Poor, Principles of Cognitive Radio", Cambridge University Press, 2013.

3. Kwang-Cheng Chen and Ramjee Prasad, " Cognitive Radio Networks" , John Wiley & Sons, Ltd, 2009.

4. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, "Cognitive Radio Networks – From Theory to Practice", Springer Series: Analog Circuits and Signal Processing, 2009.

5. J. Mitola, " Cognitive Radio: An Integrated Agent Architecture for software defined radio", Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.

6. Simon Haykin, "Cognitive Radio: Brain –empowered wireless communications", IEEE Journal on selected areas in communications, Feb 2005.

7. Ian F. Akyildiz, Won – Yeol Lee, Mehmet C. Vuran, Shantidev Mohanty, " NeXt generation /dynamic spectrum access / cognitive radio wireless networks: A Survey Elsevier Computer Networks, May 2006.

CM908 MOBILE COMMUNICATION **L T P C**
3 0 0 3

INTRODUCTION TO MOBILE COMMUNICATION SYSTEM 9

Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Second Generation (2G)Cellular Networks, Third Generation(3G) Wireless Networks. The Cellular Concept: Frequency reuse, Channel Assignment Strategies, Interference and system capacity, Trunking and Grade of Service, Improving Coverage and capacity in Cellular systems (Cell Splitting, Sectoring, A Microcell Zone Concept)

MOBILE RADIO PROPAGATION 9

Introduction to Radio Wave Propagation, Free space propagation model, Three Basic Propagation Mechanisms(reflection, diffraction, scattering), Outdoor Propagation models, Indoor propagation models, Small-Scale Multipath propagation, Impulse Response Model of a Multipath Channel, Small-Scale Multipath Measurements, Parameters of Mobile multipath channels, Types of small scale fading, Flat Fading, Frequency Selective Fading, Fast Fading , Slow Fading.

MODULATION TECHNIQUES FOR MOBILE RADIO 9

Linear Modulation Techniques(BPSK, DPSK, QPSK, Offset QPSK), Constant Envelope Modulation (BFSK, MSK, GMSK), Combined Linear and Constant Envelope Modulation Techniques (Minimum Shift Keying, Gaussian MSK, M-ary QAM, M-ary FSK, Orthogonal Frequency Division Multiplexing), Spread Spectrum Modulation Techniques, Pseudo-Noise(PN) Sequence, Direct Sequence Spread Spectrum,(DS-SS), Frequency Hopped Spread Spetrum(FH-SS),Performance of DS-SS and Performance of FH-SS.

MULTIPLE ACCESS TECHNIQUES 9

Multiple Access Techniques: Frequency Division Multiple Access(FDMA), Time Division Multiple Access(TDMA), Spread Spectrum Multiple Access, Frequency Hopped Multiple Access(FHMA) and Code Division Multiple Access(CDMA), Space Division Multiple Access(SDMA),Packet Radio Protocols, Pure ALOHA, Slotted ALOHA, Capacity of

Cellular Code Division Multiple Access and Space Division Multiple Access.

WIRELESS SYSTEMS AND STANDARDS 9

Global System for Mobile(GSM), GSM Services and Features, GSM System Architecture, GSM Radio Subsystem, GSM channels, GSM Traffic Channels and GSM Control Channels, Frame structure for GSM, Signal Processing in GSM , CDMA Digital Cellular Standard, Frequency and Channel Specifications, Forward CDMA Channel, Reverse CDMA Channel

TEXT BOOKS:

1. T S Rappaport, Wireless Communications, Pearson Education, India
2.Upen Dalal, Wireless Communication, Oxford University Press,2010

REFERENCE BOOKS:

1. W C Y Lee, Mobile Communication Engineering – Theory and Applications; TMH
2. Jochen Schiller, "Mobile Communications", Second Edition, Pearson Education, 2003.

3. William Stallings, "Wireless Communications and Networks", Pearson Education, 2002.
4. T L Singhal, Wireless Communications, Tata McGraw Hill 2010.
5. V K Garg, Wireless Communication and Networking; Morgan Kaufman Publishers India; 2008