Department of Electronics and Communication Engineering

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M.TECH. – WIRELESS COMMUNICATION SYSTEMS

REGULATIONS 2015

(Applicable to the students admitted from the Academic year 2015– 2017)

Curriculum – Revision 0

(THREE YEAR PART TIME)

CURRICULUM AND SYLLABI

(Applicable to the students admitted from the Academic year 2015– 2017)
Curriculum – Revision 0

SEMESTER I

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
QWC101	Applied Mathematics	3	1	0	4
QWC102	Wireless Communication	3	1	0	4
QWC103	Wireless Networks (Wireless Networks Lab Included)	3	0	1	4

Total Hours:12 **Total Credits:12**

SEMESTER II

CODE NO.	COURSE TITLE	L	T	P	C
QWC201	Modern Digital Communication (Modern Digital Communication Lab included)	3	0	1	4
QWC202	Advanced Digital Signal Processing	3	1	0	4
QWC203*	Elective I	3	0	0	3

Total Hours: 11 **Total Credits: 11**

SEMESTER III

CODE NO.	COURSE TITLE	L	T	P	C
	THEORY				
QWC301	Multi Carrier Communication	3	1	0	4
QWC302	Wireless Network Security	3	1	0	4
QWC303	Microwave Passive Systems (Microwave Passive Systems Lab included)	3	0	1	4
QWC304	Communication Skills	1	0	1	2

Total Hours: 14 **Total Credits: 14**

SEMESTER IV

CODE NO.	COURSE TITLE	L	T	P	C
QWC401	Advanced Radiation Systems	3	0	0	3
QWC402*	Elective – II	3	0	0	3
QWC403*	Elective – III	3	0	0	3
QWC404	Mini Project	0	0	1	1

Total Hours: 10 **Total Credits: 10**

SEMESTER V

CODE NO.	COURSE TITLE	L	T	P	C
PRACTICAL					
QWC501	Project Work (Phase I)	0	0	8	8
	MOOC-I*	0	0	0	0

Total Hours: 08 **Total Credits: 08**

SEMESTER VI

CODE NO.	COURSE TITLE	L	T	P	C
QWC601	Project Work (Phase II)	0	0	15	15
	MOOC-II*	0	0	0	0

Total Hours: 15 **Total Credits: 15**

Overall Credits:70

LIST OF ELECTIVES

Sl.No	Code No	Course Title	L	T	P	C
ELECTIVE-I						
1	QWC203A	Antenna Systems for Wireless Applications	3	0	0	3
2	QWC203B	Adhoc Networks	3	0	0	3
3	QWC203C	Modeling and Simulation of Wireless systems	3	0	0	3
4	QWC203D	Detection and Estimation Theory	3	0	0	3
5	QWC203E	Soft Computing	3	0	0	3
ELECTIVE-II						
1	QWC402A	Multimedia Compression Techniques	3	0	0	3
2	QWC402B	High Performance Computing Networks	3	0	0	3
3	QWC402C	Radar communication	3	0	0	3
4	QWC402D	Software Defined Radio	3	0	0	3
5	QWC402E	Quality of Service in Wireless Communication	3	0	0	3
ELECTIVE-III						
1	QWC403A	RF MEMS	3	0	0	3
2	QWC403B	Mobile Satellite Communication	3	0	0	3
3	QWC 403C	Remote Sensing and GIS	3	0	0	3
4	QWC403D	Free Space Optics	3	0	0	3
5	QWC403E	Electro Magnetic Interference and Compatibility	3	0	0	3

SUBCODE	SUB NAME	L	T	P	C
QWC101	APPLIEDMATHEMATICS	3	1	0	4

UNITI **9**

MATRIX THEORY

Some important matrix factorizations – The Cholesky decomposition – QR factorization– Least squares method – Singular value decomposition - Toeplitz matrices

UNIT II **9**

ONE DIMENSIONAL RANDOM VARIABLES

Random variables - Probability function – moments – moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a Random Variable**.** Two Dimensional Random Variable-Joint distributions – Marginal and Conditional distributions – Functions of two dimensional random variables – Regression Curve for means – Correlation.

UNIT III **9**

MODERN ALGEBRA

Sets- Relations and functions-Definitions; Groups-Definition and elementary properties-subgroups-abelian groups-Lagranges theorem-properties; Field-Finite fields-elementary properties- subfields-statements, properties.

UNIT IV **9**

QUEUEING MODELS

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

UNIT V **9**

SPECIAL FUNCTIONS

Bessel's equation – Bessel function – Recurrence relations - Generating function and orthogonal property for Bessel functions of first kind – Fourier-Bessel expansion.

LECTURE	TUTORIAL	TOTAL
45	15	60

REFERENCES

1. Grewal B.S., "Numerical methods in Engineering and Science", 40th edition, Khanna Publishers, 2007. [unit I]
2. Moon, T.K., Sterling, W.C., "Mathematical methods and algorithms for signal processing", Pearson Education, 2000.
3. Richard Johnson, Miller & Freund, "Probability and Statistics for Engineers", 7th Edition, Prentice – Hall of India, Private Ltd., New Delhi (2007).[unit III &IV]
4. Taha, H.A., "Operations Research, An introduction", 7th edition, Pearson education editions, Asia, New Delhi, 2002.[unit V]
5. Bronson.R, Matrix operation, Schaum's outline series, Mc Graw Hill, New York(1989) [unit II]
6. Grewal,B.S, Higher Engineering Mathematics, 37th edition, Khanna Publishers,2003. [unit I]
7. Ramana B.V, Higher Engineering Mathematics –Tata McGraw Hill, 2007 [unit I]
8. Numerical methods for scientific and engineering computation" by M.K.Jain, S.R.K. Iyengar and R.K.Jain - 5th edition New age International Publishers 2007. [Unit II].

9. Donald Gross and Carl M. Harris, “Fundamentals of Queuing theory”, 2nd edition, John Wiley and Sons, New York (1985)

10. John B.Fraleigh, “ A first course in Abstract algebra”, third edition, Narosa publishing House, Newdelhi.

SUBCODE	SUB NAME	L	T	P	C
QWC102	WIRELESS COMMUNICATION	3	1	0	4

UNIT I **9**

WIRELESS CHANNEL

Introduction to wireless systems,Transmitter-Receiver Architecture-Wireless Standards. Physical modeling for the wireless channel-Free space, fixed transmit and receive antennas; Free space, moving antenna; Reflecting wall, fixed antenna reflecting wall; moving antenna Reflection from a ground plane; Power decay with distance and shadowing; Moving antenna, multiple reflectors; Input /output model of the wireless channel - The wireless channel as a linear time-varying system; Baseband equivalent model; A discrete-time baseband model; Additive white noise; Time and frequency coherence ; Doppler spread and coherence time; Delay spread and coherence bandwidth ,Statistical channel models- Rayleigh and Rician fading.

UNIT II **9**

POINT TO POINT COMMUNICATION, DETECTION, DIVERSITY

Non-coherent detection, Coherent detection From BPSK to QPSK: exploiting the degrees of freedom Diversity, Time diversity Repetition coding, Time diversity code design criterion, Time diversity in GSM. Antenna diversity- Receive diversity Transmit diversity, space-time codes MIMO, MIMO schemes Frequency diversity-Basic concept Single-carrier with ISI equalization Direct-sequence spread-spectrum, Orthogonal frequency division multiplexing ,Communication over frequency-selective channels. Impact of channel uncertainty -Non-coherent detection for DS spread-spectrum, Channel estimation, other diversity scenarios

UNIT III **9**

CELLULAR SYSTEMS AND CHANNEL CAPACITY

Multiple access and interference management , Narrowband and wideband systems, Capacity of wireless channels -AWGN channel capacity, Resources of the AWGN channel, Linear time-invariant Gaussian channels, Capacity of fading channels, Multiuser capacity-uplink AWGN channel, Downlink AWGN channel, uplink fading channel, downlink fading channel

UNIT IV **9**

SPATIAL MULTIPLEXING AND CHANNEL MODELING

Multiplexing capability of deterministic MIMO channels- Capacity via singular value decomposition - Physical modeling of MIMO channels- Modeling of MIMO fading channels-MIMO II: capacity and multiplexing architectures -The V-BLAST architecture, Fast fading MIMO channel- Receiver architectures

UNIT V **9**

MIMO IV: MULTIUSER COMMUNICATION

Uplink with multiple receive antennas -MIMO uplink- Downlink with multiple transmit antennas. MIMO downlink-Multiple antennas in cellular networks: a system view

LECTURE	TUTORIAL	TOTAL
45	15	60

TEXT BOOK

1.David Tse and Pramod Viswanath, Fundamentals of Wireless Communication, Cambridge University Press, 2005.

2.T.S.Rappaport “Wireless Communication” Pearson Education, 2002

3.E.A.Lee and D.G.Messerschmitt “Digital Communication” 2nd Ed., Allied Pub,1994.

4.John .G.Proakis “Digital Communications” 4th Ed. Mc Graw Hill Int. Ed.,2000.
5.Feher K., “Wireless digital communications”, PHI, New Delhi, 1995.
6. Rappaport T.S., “Wireless Communications; Principles and Practice”, Prentice Hall, NJ, 1996.
7. Lee W.C.Y., “Mobile Communications Engineering: Theory and Applications”, Second Edition, McGraw-Hill, New York, 1998.
8.Schiller, “Mobile Communications”, Pearson Education Asia Ltd., 2000
9.Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005 10. Andreas F. Molisch , “Wireless Communications”, Wiley - IEEE, 2011.
11. James B. Y. Tsui, “Special Design Topics in Digital Wideband Receivers”, Artech House Radar Library, 2009

SUBCODE	SUB NAME	L	T	P	C
QWC103	WIRELESS NETWORKS (WIRELESS NETWORKS LAB INCLUDED)	3	0	1	4

UNIT I **9**

PHYSICAL AND WIRELESS MAC LAYER ALTERNATIVES

Wired transmission techniques: design of wireless modems, power efficiency, out of band radiation, applied wireless transmission techniques, short distance base band transmission, VWB pulse transmission, broad Modems for higher speeds, diversity and smart receiving techniques, random access for data oriented networks, integration of voice and data traffic.

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UNIT II **9**

WIRELESS NETWORK PLANNING AND OPERATION

Wireless networks topologies, cellular topology, cell fundamentals signal to interference ratio calculation, capacity expansion techniques, cell splitting, use of directional antennas for cell sectoring, micro cell method, overload cells, channels allocation techniques and capacity expansion FCA, channel borrowing techniques, DCA, mobility management, radio resources and power management securities in wireless networks.

UNIT III **9**

WIRELESS WAN

Mechanism to support a mobile environment, communication in the infrastructure, IS-95 CDMA forward channel, IS – 95 CDMA reverse channel, pallert and frame formats in IS – 95, IMT – 2000; forward channel in W-CDMA and CDMA 2000, reverse channels in W-CDMA and CDMA-2000, GPRS and higher data rates, short messaging service in GPRS mobile application protocols.

UNIT IV **9**

WIRELESS LAN

Historical overviews of the LAN industry, evolution of the WLAN industry, wireless home networking, IEEE 802.11. The PHY Layer, MAC Layer, wireless ATM, HYPER LAN, HYPER LAN – 2.

UNIT V **9**

WPAN AND GEOLOCATION SYSTEMS

IEEE 802.15 WPAN, Home RF, Bluetooth, interface between Bluetooth and 802.11, wireless geolocation technologies for wireless geolocation, geolocation standards for E.911 service.

LECTURE	PRACTICAL	TOTAL
45	30	75

REFERENCES

1. Kaveh Pahlavan, Prashant Krishnamoorthy, Principles of Wireless Networks, - A united approach - Pearson Education, 2002.
2. Jochen Schiller, Mobile Communications, Person Education – 2003, 2nd Edn.
3. X.Wang and H.V.Poor, Wireless Communication Systems, Pearson education, 2004.
4. M.Mallick, Mobile and Wireless design essentials, Wiley Publishing Inc. 2003.
5. P.Nicopolitidis, M.S.Obaidat, G.I. papadimitria, A.S. Pomportsis, Wireless Networks, John

Wiley & Sons, 2003.

LIST OF EXPERIMENTS

1. Analysis of wireless network with wireshark.
2. TCL scripts and Xgraph.
3. Comparison of DSDV,DSR and AODV Routing protocols.
4. Implementation of MAC algorithm for wireless network.
5. Program to implement energy models for wireless nodes.
6. Implementation of symmetric key encryption using Ns2.
7. Implementation of Gray hole and wormhole attack in Ns2.
8. Program to calculate packet delivery ratio,packet loss,throughput,end to end delay and routing overhead for Wireless Networks.
9. Implementation of congestion control algorithms.
10. Simulate a wireless Personal Area Networks.
11. Measurement on the effect of RTS/CTS on a wireless link.
12. Performance comparison of GSM and CDMA networks

REFERENCES:

1. Advanced Network Technologies Virtual Lab @ www.virtual-labs.ac.in/cse28/
2. www.winlab.rutgers.edu/zhibinwu/pdf/tr_ns802_11.pdf
3. www.ittc.ku.edu/jpgs/courses/.../lecture-lab-intro2ns3-print.pdf 4. www.isi.edu/nsnam/ns/

SUBCODE	SUB NAME	L	T	P	C
QWC201	MODERN DIGITAL COMMUNICATION (MODERN DIGITAL COMMUNICATION LAB INCLUDED)	3	0	1	4

UNIT I — **8**

POWER SPECTRUM AND COMMUNICATION OVER MEMORYLESS CHANNEL:

Review of Autocorrelation and Spectral density, PSD of a synchronous data pulse stream; M-ary Markov source; Continuous phase modulation – Scalar and vector communication over memoryless channel – Detection criteria.

UNIT II — **12**

BLOCK CODED DIGITALCOMMUNICATION:

Architecture and performance – Binary block codes; Orthogonal; Biorthogonal; Tran orthogonal; Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed – Solomon codes.

CONVOLUTIONALCODED DIGITALCOMMUNICATION:

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

UNIT III — **8**

OPTIMUM RECEIVERS

Shannon's channel coding theorem; Channel capacity; Optimum Receiver; Correlation demodulator, Matched filter demodulator, properties of the matched filter, Frequency domain interpretation of the matched filter.

UNIT IV — **9**

COHERENTAND NON-COHERENT COMMUNICATION:

Coded BPSK and DPSK demodulators Detections of Signals in Gaussian Noise: Decision Regions-correlation receivers- coherent detection- detection of PSK and multiple PSK-BER analysis-sampled matched filter-coherent detection of FSK - BER analysis. Non coherent Detection: Detection of DPSK, FSK-BER analysis- Performance of Non Coherent detection in Random phase, Rayleigh and Rician channels.

UNIT V — **8**

BANDLIMITED CHANNELSAND DIGITALMODULATIONS:

Eye pattern; demodulation in the presence of ISI and AWGN; Equalization techniques Detection and demodulation– IQ modulations; QPSK; QAM;8PSK,16APSK -BER Performance Analysis. – Continuous phase modulation; CPFM; CPFSK; MSK, OFDM.

LECTURE	PRACTICAL	TOTAL
45	30	75

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, 2007
3. Bernard Sklar,"Digital Communications Fundamentals and Applications", 2nd Edition, Prentice Hall PTR, Upper Sadle River, New Jersey,2002.
4. B.P.Lathi Modern digital and analog communication systems, 3rd Edition, Oxford

University press 1998.
5. Haykins, “Communication Systems”, 5th ed., John Wiley, 2008. [Unit-I, III, V].
6. M. K. Simon and M. S. Alouini,” Digital Communication over Fading Channels”,Wiley-Interscience, 2nd Edition 2005.
7. R. G. Gallager, “Principles of Digital Communication”, Cambridge University Press, 2008.
8. A. Lapidoth, “A Foundation in Digital Communication”,Cambridge University Press, 2009

LIST OF EXPERIMENTS

Experiments based on Matlab/Scilab

1. Implementation of Linear, Cyclic and REED SOLOMON codes.
2. STBC coding and decoding
3. Comparison of LE, DFE, MMSE, MLSD for ISI channel.
4. Viterbi decoding
5. Implementation of GMSK and π/4 QPSK modulation and spectrum Analysis.
6. BER analysis of 16-QAM, 64-QAM, QPSK, MSK.
7. BER analysis of QPSK and MSK.
8. Wireless channel modeling
9. Implementation of DSSS, FHSS Techniques
10. Implementation of OFDM.
11. UWB waveforms generation
12. Study of physical layer characteristics of WiFi or WiMAx or Bluetooth, **WIFI**-Hotspot**,LIFI.**

REFERENCES:

http://www.vlab.co.in/
http://203.110.240.139/
http://iitg.vlab.co.in/?sub=59&brch

=163 http://solve.nitk.ac.in/

SUBCODE	SUB NAME	L	T	P	C
QWC202	ADVANCED DIGITAL SIGNAL PROCESSING	3	1	0	4

UNIT I **10**

DISCRETE RANDOM SIGNALPROCESSING

Discrete Random Processes-Ensemble averages,stationary processes,Autocorrelation and Auto covariance matrices. Parseval's Theorem, Wiener-Khintchine Relation- Power Spectral Density-Periodogram Spectral Factorization, Filtering random processes. Low Pass Filtering of White Noise. Parameter estimation: Bias and consistency--Multirate signal Processing

UNIT II **8**

SPECTRUM ESTIMATION

Estimation of spectra from finite duration signals, Non-Parametric Methods-Correlation Method , Periodogram Estimator, Performance Analysis of Estimators -Unbiased, Consistent Estimators-Modified periodogram, Bartlett and Welch methods, Blackman – Tukey method. Parametric Methods - AR, MA, and ARMA model based spectral estimation. Parameter Estimation -Yule-Walker equations, solutions using Durbin's algorithm

UNIT III **9**

LINEAR ESTIMATIONAND PREDICTION

Linear prediction- Forward and backward predictions, Solutions of the Normal equations - Levinson-Durbin algorithms. Least mean squared error criterion -Wiener filter for filtering and prediction, FIR Wiener filter and Wiener IIR filters.

UNIT IV **9**

ADAPTIVE FILTERS

FIR adaptive filters -adaptive filter based on steepest descent method-Widrow-Hoff LMS adaptive algorithm, Normalized LMS. Adaptive channel equalization-Adaptive echo cancellation-Adaptive noise cancellation- Adaptive recursive filters (IIR). RLS- adaptive filters-Exponentially weighted RLS-sliding window RLS.

UNIT V **9**

FILTER BANK AND WAVELETS

Quadrature Mirror Filter- Paraunitary Filter Banks- Biorthogonal Linear Phase Filter banks – Uniform M Channel Filter banks – Tree Structured Filter Banks- Wavelet Transform- Filter Banks and Wavelet – Properties of Wavelets – Scaling Function – Construction of wavelets- Examples of Wavelet Systems- Applications of Wavelets

LECTURE	TUTORIAL	TOTAL
45	15	60

REFERENCES :

1. John G.Proakis, Dimitris G.Manolakis, Digital Signal Processing Pearson Education, 2002.
2. John G.Proakis et.al.,'Algorithms for Statistical Signal Processing', Pearson Education, 2002.
3. Dimitris G.Manolakis et.al.,'Statistical and adaptive signal Processing', McGraw Hill, Newyork,2000.
4. N.J.Fliege, "Multirate Signal Processing'PHI, 1995
5. C.Sidney Burrus, Ramesh A Gopinath and Haitao Guo," Introduction to Wavelets and Wavelet Transforms – A Primer" Prentice Hall International, editions, 1998.
6. Rabiner and Crochier, "Multirate Signal Processing" PHI, 1987.

7. Raghuveer M Rao, “Introduction to Wavelet Transform”, New Age International, 2000.
8. Monson H.Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, Inc.,Singapore, 2002.
9. Rafael C. Gonzalez, Richard E.Woods, ‘Digital Image Processing’, Pearson Education, Inc., Second Edition, 2004.(For Wavelet Transform Topic)
10. John G. Proakis and Dimitris K Manolakis “Digital Signal Processing”, Pearson Education, 4th Edition, 2009 (V-unit)
11. Richard G. Lyons “Understanding Digital Signal Processing” , Prentice Hall, 3rd Edition, 2010
12. Alan V. Oppenheim and Ronald W. Schafer “Discrete-Time Signal Processing” 3rd Edition, Prentice Hall, 2009.

SUBCODE	SUB NAME	L	T	P	C
QWC301	MULTICARRIER COMMUNICATION	3	1	0	4

UNIT I **9**

FUNDAMENTALS OF OFDM/OFDMA SYSTEMS

Mobile channel modeling- Parameters of wireless channels, Categorization of fading channels. Conventional methods for channel fading mitigation-Time-selective fading, Frequency-selective fading. OFDM systems- System architecture, Discrete-time model of an OFDM system, Spectral efficiency, Strengths and drawbacks of OFDM. OFDM-based multiple access schemes.

UNIT II **9**

SYSTEM IMPERFECTIONS

Time and frequency synchronizations-Sensitivity to timing and frequency errors, Synchronizations for downlink transmission, Synchronizations for uplink transmissions.Peak-to-Average Power Ratio (PAPR)-definitions, Statistical properties of PAPR, PAPR reduction techniques. Channel estimation and equalization techniques.

UNIT III **9**

OFDM PERFORMANCE

OFDM System Performance over AWGN Channels-Clipping Amplification, BER Performance Using Clipping Amplifiers, Signal Spectrum with Clipping Amplifier. Analogue- to-Digital Conversion, Phase Noise -Effects of phase noise, White Phase Noise Model, coloured phase noise, OFDM transmission over wideband channel-channel model, Effects of Time Dispersive Channels on OFDM, system performance over dispersive channel.

UNIT IV **9**

MC CDMA 9

OFDM versus MC-CDMA, CDMA- MC-CDMA, MC-DS-CDMA, MT- CDMA, MC- MC-CDMA System. Basic spreading sequences, MC-CDMA System Performance in Synchronous Environment, Advanced peak factor reduction techniques.

UNIT V **9**

APPLICATIONS OF OFDM AND MC-CDMA

Digital Broadcasting- Digital Audio Broadcasting, Terrestrial Digital Video Broadcasting, Terrestrial Integrated Services Digital Broadcasting, GHz-Band Wireless LANs- IEEE 802.11g , IEEE 802.11h , IEEE 802.16a.

LECTURE	TUTORIAL	TOTAL
45	15	60

REFERENCES

1. Man-On Pun Michele Morelli C-C Jay Kuo , "Multi-Carrier Techniques For Broadband Wireless Communications A Signal Processing Perspective" 2007 by Imperial College Press
2. Hara, Shinsuke. Multicarrier techniques for 4G mobile communications Artech House Universal personal communications series 2003
3. OFDM and MC-CDMA A Primer L. Hanzo, T. Keller 2006 John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England
4. Liu, Hui, OFDM-based broadband wireless networks : design and optimization 2005 by John Wiley & Sons
5. Lie Liang Yang, "Multicarrier Communications", John Wiley & Sons

Ltd, 2009 6. Andreas F. Molisch, “Wireless Communications”, Wiley - IEEE, 2011.
6. James B. Y. Tsui, “Special Design Topics in Digital Wideband Receivers”, Artech House Radar Library, 2009.

SUBCODE	SUB NAME	L	T	P	C
QWC302	WIRELESS NETWORK SECURITY	3	1	0	4

Unit I — **9**

Wireless Information warfare: Protecting privacy and means of communication, taxonomies of wireless communication based on network architecture mobility, model for cost effective risk management, cryptographic attacks, key management, securing wireless LANS, Electromagnetic capture threats, wireless threat analysis, securing wireless LAN countermeasures.

UNIT -II — **9**

Wireless LAN transmission media:

WAP security architecture, BLUETOOTH, wireless access to internet. **Cryptographic Security:** Classical crypt analysis, digital cryptography**,** DES modern cipher breaking, non-keyed message digest, public key cryptography, Diffie – Hellman and Elliptic curve cryptography, comparison of public key crypto systems.

UNIT –III — **9**

Network Security Components:

Network security model, network intrusion protection and detection, Host based security, virtual private networking, event correlation, wireless security components, secure configuration , secure authentication, encryption, wireless device placement.

UNIT –IV — **9**

Integrating Wireless Access into the network security process:

Logging wireless events, policy issues, accessing wireless network security, change control and device administration, wireless security models, Cisco implementation with LEAP,, WLAN authentication and key management with radius, wireless access with IP security, secure wireless public access, secure wireless point to point connectivity.

UNIT –V — **9**

Hardware perspective for end to end security in wireless application:

Taxonomy of communication systems, protocol sensitive communication security , evolution towards wireless, hardware and software avenues, encryptor structures in wireless- interception and vulnerability of wireless systems, communication ESMs and interception receivers, SAW technology.

REFERENCE BOOKS

1. Randall K. Nichols, Panos C. Lekkas, “Wireless Security Models, Threats and solutions”. McGrawHill, 2005.
2. Brian Carter, Russel Shumway, “Wireless Security End to End”, CISSPl, 2005.
3. Merrit Maxim, David Pollino, “Wireless Security”, RSA Press, 2005.
4. Cyrus Peikari, Seth Fogie, , “Maximum Wireless Security ”, SAMS, 2005.

	LECTURE	TUTORIAL	TOTAL
	45	15	60

SUBCODE	SUB NAME	L	T	P	C
QWC303	MICROWAVE PASSIVE SYSTEMS (MICROWAVE PASSIVE SYSTEMS LAB INCLUDED)	3	0	1	4

UNIT I **9**

Microwave Circuits: **S parameters**: reciprocal networks, Lossless networks, **Planar transmission Lines:** Micro strip, Slot line, Strip and coplanar lines.

UNIT –II **9**

Impedance matching: Matching with lumped elements, Stub matching- Single and double stub using Smith chart solutions, Quarter wave transformer, tapered lines- Exponential taper, triangular taper.

UNIT III **9**

Passive circuit design: wave guide based Directional coupler, E & H plane Tee junction,hybridT,isolator,circulator,slotted line section,Frequencymeter,Attenuator,microwave Antenna

UNIT –IV **9**

Microwave Integrated Passive circuits:

Power divider coupler Wilkinson power divider90 degreeHybrid Coupler,180 degree coupler, Filter design: Periodic structures, Insertion loss method, maximally flat low pass filter, stepped impedance low pass filter, filter transformation, filter implementation.

UNIT-V **9**

Microwave systems: RF transceiver,Microwavestandards,Satellitelink,Cellular Communication system,Radar systems

	LECTURE	PRACTICAL	TOTAL
	45	30	75

Reference Books

1. David M. Pozar," Microwave Engineering," John Wiley & Sons, 1998.
2. David M. Pozar," Microwave & RF Design of Wireless Systems," John Wiley & Sons, 1998.
3. R.E.Collin," Foundations of Microwave Engineering," Tata McGraw Hill, 1995.
4. www.agilent.com

LIST OF EXPERIMENTS:

EM simulator

1. Experimentation with:

- Directional coupler
- Circulator
- Isolator
- Attenuator
- Slotted line bench
- Microwave horn antenna

2.Directional Simulation of Planar Transmission Lines and matching network

3. Simulation of Microwave Filters

4. Couplers and Power dividers

5. Patch antenna

SUBCODE	SUB NAME	L	T	P	C
QWC401	ADVANCED RADIATION SYSTEMS	3	0	0	3

UNIT I **9**

BASIC CONCEPTS OF RADIATION

Radiation from surface current and current line current distribution, Basic antenna parameters, Radiation mechanism-Current distribution of an Antennas, Impedance concept-Balance to Unbalanced transformer.

UNIT II **9**

RADIATION FROM APERTURES

Field equivalence principle, Rectangular and circular apertures, Uniform distribution on an infinite ground plane, Aperture fields of Horn antenna-Babinets principle, Geometrical theory of diffraction, Reflector antennas, and Design considerations - Slot antennas.

UNIT III **9**

SYNTHESIS OF ARRAY ANTENNAS

Types of linear arrays, current distribution in linear arrays, Phased arrays, Optimization of Array patterns, Continuous aperture sources, Antenna synthesis techniques.

UNIT IV **9**

MICRO STRIP ANTENNAS

Radiation mechanisms, Feeding structure, Retangular patch, Circular patch, Ring antenna. Input impedance of patch antenna, Microstrip dipole, Microstrip arrays

UNIT V **9**

EMI S/EMC/ANTENNA MEASUREMENTS

Log periodic, Bi-conical, Log spiral ridge Guide, Multi turn loop, Travelling Wave antenna, Antenna measurement and instrumentation ,Amplitude and Phase measurement, Gain, Directivity. Impedance and polarization measurement, Antenna range, Design and Evaluation

TOTAL : 45 0 45

REFERENCES:

1. Kraus.J.D.,"Antennas"II Edition, John wiley and Sons, 1997
2. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982 3. Collin.R.E. and Zucker.F.,"Antenna Theory"Part I,Mc Graw Hill, New York,1969
4. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications”, Springer, 2010.
5. Michael B. Steer , “Microwave and RF Design: A Systems Approach”, SciTech Publishing, 2009.
6. Ken Kuang, Franklin Kim and Sean S. Cahill, “RF and Microwave Microelectronics Packaging”, Springer, 2009.
7. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition (IEEE Press Series on Microelectronic Systems) , 2010

ELECTIVES LIST

SUBCODE	SUB NAME	L	T	P	C
QWC 203A	ANTENNA SYSTEMS FOR WIRELESS APPLICATIONS	3	0	0	3

UNIT I — **9**

HANDSET ANTENNAS

Introduction-Performance requirements-Electrically small Antennas-classes of Handset Antennas-The quest for Efficiency and Extended Bandwidth-Practical design-starting points for Design and optimization-RF performance of typical handsets

UNIT II — **9**

RFID TAG ANTENNAS

RFID fundamentals,Design considerations for RFID Tag Antennas,Effect of Environment on RFID Tag Antennas

UNIT III — **9**

LAPTOP ANTENNA DESIGN AND EVALUATION

Laptop related Antenna Issues-Antenna Design Methodology-PC Card Antenna Performance and Evaluation-Link Budget model-Dualband examples-Antennas for wireless wide Area Network Applications-Ultra wide band Antennas

UNIT IV — **9**

ANTENNA ISSUES IN MICROWAVE THERMAL THERAPIES

Microwave thermal therapies-Interstitial Microwave Hyperthermia-clinical trials

UNIT V — **9**

ANTENNAS FOR WEARABLE DEVICES AND UWB APPLICATIONS

Antenna design requirements for wireless Body Area Network/PAN-modelling and characterization of wearable Antennas-WBAN Radio channel characterization and effect of Wearable Antennas-case study-UWB wireless systems-challenges in UWB Antenna Design-state of the art solutions-case study.

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LECTURE		TOTAL
45	0	45

REFERENCES:

1. Zhi Ning Chen “Antennas for Portable devices” Wiley, 2007.
2. Constatine A.Balanis “Modern Antenna Handbook”Wiley august 2008
3. Nemai Chandra Karmakar “Handbook of Smart Antennas for RFID Systems”Wiley
4. Mehmet R.Yuce,Jamil Y.Khan “Wireless body Area Networks:Technology,Implementation and Applications”CRC Press.

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SUBCODE	SUB NAME	L	T	P	C
QWC203B	ADHOC NETWORKS	3	0	0	3

UNIT I **9**

WIRELESS LAN, PAN, WAN AND MAN

Introduction to adhoc networks – definition, characteristics features, applications. Characteristics of wireless channel, Fundamentals of WLANs, IEEE 802.11 standard, HIPERLAN Standard, First-, Second-, and third- generation cellular systems, WLL, Wireless ATM, IEEE 802.16 standard, HIPERACCESS, AdHoc Wireless Internet.

UNIT II **9**

MAC, ROUTING AND MULTICAST ROUTING PROTOCOLS

MAC Protocols: Design issues, goals and classification, Contention –based protocols with reservation and scheduling mechanisms, Protocols using directional antennas. Routing protocols: Design issues and classification, Table-driven, On-demand and Hybrid routing protocols, Routing protocols with efficient flooding mechanisms, Hierarchical and power-aware routing protocols. Multicast Routing Protocols: Design issues and operation, Architecture reference model, classification, Tree-based and Mesh-based protocols, Energy-efficient multicasting.

UNIT III **9**

TRANSPORT LAYER AND SECURITY PROTOCOLS

Transport layer Protocol: Design issues, goals and classification, TCP over AdHoc wireless Networks, Security, Security requirements, Issues and challenges in security provisioning, Network security attacks, Security routing. Quality of Service: Issues and challenges in providing QoS, Classification of QoS solutions, MAC layer solutions, Network layer solutions, QoS frameworks. HIPERMAN WIRELESS SECURITY - WEP/WPA(ENCRYPTION AND DECRYPTION)

UNIT IV **9**

ENERGY MANAGEMENT AND WIRELESS SENSOR NETWORKS

Need, classification of battery management schemes, Transmission power management schemes, System power management schemes.Wireless Sensor Networks: Architecture, Data dissemination, Date gathering, MAC protocols, location discovery, Quality of a sensor network.

UNIT V **9**

PERFORMANCE ANALYSIS

ABR beaconing, Performance parameters, Route-discovery time, End-to-end delay performance, Communication throughput performance, Packet loss performance, Route reconfiguration/repair time, TCP/IP based applications.

LECTURE	TOTAL
45	45

REFERENCES:

1. C. Siva Ram Murthy and B.S. Manoj, AdHoc Wireless Networks: Architectures and protocols, Prentice Hall PTR, 2004
2. C.-K.Toh, AdHoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall PTR, 2001
3. Mohammad Ilyas, The Handbook of AdHoc Wireless Networks, CRC press, 2002 Charles E. Perkins, AdHoc Networking, Addison – Wesley, 2000
4. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan Stojmenovic, Mobile

AdHoc Networking, Wiley – IEEE press, 2004.

SUBCODE	SUB NAME	L	T	P	C
QWC203C	MODELING AND SIMULATION OF WIRELESS SYSTEMS	3	0	0	3

UNIT I **9**

SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS

Univariate and multi-variate models, Transformation of random variables, Bounds and approximation, Random process models-Markov AND ARMA sequences, Sampling rate for simulation, Computer generation and testing of random numbers.Case study- simulation using C++.

UNIT II **9**

MODELING OF COMMUNICATION SYSTEMS

Information Sources, Formatting/Source Coding, Digital Waveforms, Line Coding, Channel Coding, Radio frequency and Optical Modulation, Demodulation and Detection, Filtering, Multiplexing/Multiple Access, Synchronization, Calibration of Simulations.

UNIT III **9**

COMMUNICATION CHANNELS & MODELS

Fading & Multipath Channels, Almost Free-Space Channels, Finite State Channel Models, Methodology for Simulating Communication Systems Operating over Fading Channels, Reference Models for Mobile Channels: GSM, UMTS-IMT-2000

UNIT IV **9**

ESTIMATION OF PARAMETERS IN SIMULATION:

Quality of an estimator, estimating the Average Level of a Waveform, Estimating the Average power of a waveform, estimating the Power Spectral Density of a process, Estimating the Delay and Phase.

UNIT V **9**

ESTIMATION OF PERFORMANCE MEASURES FROM SIMULATION:

Estimation of SNR, Performance Measures for Digital Systems, Importance sampling method, Efficient Simulation using Importance Sampling, Quasianalytical Estimation. Case Studies: 16-QAM Equalized Line of Sight Digital Radio Link, CDMA Cellular Radio System. Case studies-Simulated wireless model using C++.

LECTURE	TOTAL
45	45

REFERENCES

1. M.C. Jeruchim, Philip Balaban and K.Sam Shanmugam, "Simulation of Communication Systems Modeling, Methodology and Techniques", Kluwer Academic/Plenum Publishers, New York, 2000.
2. C. Britton Rorabaugh, "Simulating Wireless Communication Systems: Practical Models In C++", Prentice Hall, 2004.
3. William H. Tranter, K. Sam Shanmugan, Theodore S. Rappaport, Kurt L. Kosbar, "Principles of Communication Systems Simulation with Wireless Applications", Prentice Hall PTR, 2002.
4. John G. Proakis, Masoud Salehi, Gerhard Bauch, Bill Stenquist, Tom Ziolkowski, "Contemporary Communication Systems Using MATLAB" Thomson-Engineering, 2nd Edition, 2002.
5. Thomas Krag and Sebastin Buettrich, "Wireless Mesh Networking", O'Reilly Publishers, 2007.

SUBCODE	SUB NAME	L	T	P	C
QWC203D	DETECTION AND ESTIMATION THEORY	3	1	0	4

UNIT I **8**

BACKGROUND AND STATISTICAL DECISION THEORY:

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

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

UNIT II **12**

DETECTION OF DETERMINISTIC SIGNALS AND RANDOM SIGNALS: Matcl

sinusoid with unknown amplitude, phase, frequency and arrival time, linear model. Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

UNIT III **9**

NONPARAMETRIC DETECTION:

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

UNIT IV **8**

ESTIMATION OF SIGNAL PARAMETERS:

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

UNIT V **7**

SIGNAL ESTIMATION IN DISCRETE-TIME: Linear Bayesian estimation, Weiner filtering, Kalman filtering.

LECTURE	TOTAL
45	45

REFERENCES

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. H. V. Poor, "An Introduction to Signal Detection and Estimation", Springer, 2/e, 1998.
3. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.
4. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
5. http://nptel.iitm.ac.in/courses.php?disciplineId=117
6. R. G. Gallager, “Principles of Digital Communication”, Cambridge University Press, 2008.
7. A. Lapidoth, “A Foundation in Digital Communication”,Cambridge, 2009.
8. Weeks Michael, “Digital Signal Processing Using MATLAB and Wavelets”,

Firewall Media, 2011.

SUBCODE	SUB NAME	L	T	P	C
QWC203E	SOFT COMPUTING	3	0	0	3

UNIT I **10**

FUZZY SET THEORY

Introduction to Neuro – Fuzzy and Soft Computing – Fuzzy Sets – Basic Definition and Terminology – Set-theoretic Operations – Member Function Formulation and Parameterization – Fuzzy Rules and Fuzzy Reasoning – Extension Principle and Fuzzy Relations – Fuzzy If-Then Rules – Fuzzy Reasoning – Fuzzy Inference Systems – Mamdani Fuzzy Models – Sugeno Fuzzy Models – Tsukamoto Fuzzy Models – Input Space Partitioning and Fuzzy Modeling.

UNIT II **8**

OPTIMIZATION

Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method – Step Size Determination – Derivative-free Optimization – Genetic Algorithms – Simulated Annealing – Random Search – Downhill Simplex Search.

UNIT III **10**

NEURAL NETWORKS

Supervised Learning Neural Networks – Perceptrons - Adaline – Backpropagation Mutilayer Perceptrons – Radial Basis Function Networks – Unsupervised Learning Neural Networks – Competitive Learning Networks – Kohonen Self-Organizing Networks – Learning Vector Quantization – Hebbian Learning.

UNIT IV **9**

NEURO FUZZY MODELING

Adaptive Neuro-Fuzzy Inference Systems – Architecture – Hybrid Learning Algorithm – Learning Methods that Cross-fertilize ANFIS and RBFN – Coactive Neuro Fuzzy Modeling – Framework Neuron Functions for Adaptive Networks – Neuro Fuzzy Spectrum.

UNIT V **8**

APPLICATIONS OF COMPUTATIONAL INTELLIGENCE

Printed Character Recognition – Inverse Kinematics Problems – Automobile Fuel Efficiency Prediction – Soft Computing for Color Recipe Prediction.

LECTURE	TOTAL
45	45

REFERENCES

1. Timothy J.Ross, "Fuzzy Logic with Engineering Applications", McGraw-Hill, 1997.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
3. S. Rajasekaran and G.A.V.Pai, "Neural Networks, Fuzzy Logic and Genetic Algorithms", PHI, 2003.
4. R.Eberhart, P.Simpson and R.Dobbins, "Computational Intelligence - PC Tools", AP Professional, Boston, 1996.
5. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, "Neuro-Fuzzy

and Soft Computing", Prentice-Hall of India, 2003.
6. George J. Klir and Bo Yuan, "Fuzzy Sets and Fuzzy Logic-Theory and Applications", Prentice Hall, 1995.
7. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Edn., 2003.
8. Mitchell Melanie, "An Introduction to Genetic Algorithm", Prentice Hall, 1998.
9. David E. Goldberg, "Genetic Algorithms in Search, Optimization and Machine Learning", Addison Wesley, 1997.
10. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using MATLAB", Springer, 2007.
11. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", PHI, 2004, Pearson Education 2004.

SUBCODE	SUB NAME	L	T	P	C
QWC402A	MULTIMEDIA COMPERESSION TECHINIQUES	3	0	0	3

UNIT I **9**

INTRODUCTION

Special features of Multimedia – Graphics and Image Data Representations - Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications -Need for Compression - Taxonomy of compression techniques – Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies

UNIT II **9**

TEXT COMPRESSION

Compaction techniques – Huffmann Arithmatic coding – Shannon-Fano coding algorithms. coding – Adaptive Huffmann Coding – – Dictionary techniques – LZW family

UNIT III **9**

AUDIO COMPRESSION

Audio compression techniques - μ- Law and A- Law companding. Frequency domain and filtering – Basic sub-band coding – Application to speech coding – G.722 – Application to audio coding – MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders

UNIT IV **9**

IMAGE COMPRESSION

Predictive techniques – DM, PCM, and DPCM: Optimal Predictors and Optimal Quantization– contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders – JPEG 2000 standards - JBIG, JBIG2 standards

UNIT V **9**

VIDEO COMPRESSION

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2– MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video

LECTURE	TOTAL
45	45

REFERENCES

1. . Khalid Sayood: Introduction to Data Compression, Morgan Kauffman Harcourt India,2nd Edition, 2000.
2. David Salomon: Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q.Shi, Huifang Sun : Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.
4. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004. 5. Mark Nelson: Data compression, BPB Publishers, New Delhi,1998.
6. Mark S.Drew, Ze-Nian Li : Fundamentals of Multimedia, PHI, 1 Edition, 2003.
7. Watkinson,J : Compression in Video and Audio, Focal press,London.1995.

8. Jan Vozer : Video Compression for Multimedia, AP Profes, NewYork, 1995
9. Andy Beach, "Real World Video Compression", Pearson Education, 2010.
10. Irina Bocharova , "Compression for Multimedia", Cambridge University Press, 2010.
11. Arjuna Marzuki, Ahmad Ismat Bin Abdul Rahim and Mourad Loulou, "Advances in Monolithic Microwave Integrated Circuits: Modeling and Design Technologies", (Premier Reference source), 2011.

SUBCODE	SUB NAME	L	T	P	C
QWC402B	HIGH PERFORMANCE COMPUTING NETWORKS	3	0	0	3

UNIT I **9**

BASICS OF NETWORKS

Telephone, computer, Cable television and Wireless network, networking principles, Digitalization Service and layered architecture, traffic characterization and QOS, networks services network elements and network mechanisms.

UNIT II **9**

PACKET SWITCHED NETWORKS

OSI and IP models Ethernet (IEEE 802.3); token ring (IEEE 802.5), FDDI, DQDB, frame relay, SMDS, Internet working with SMDS.

UNIT –III **9**

INTERNET AND TCP/IP NETWORKS

Overview, internet protocol, TCP and VDP, Performance of TCP/IP networks circuits switched networks SONET DWDM, Fiber to home, DSL, Intelligent networks, CATV.

UNIT –IV **9**

ATM AND WIRELESS NETWORKS

Main features addressing, signaling and routing ATM header structureadaptation layer, management and control, BISDN, Inter working with ATM, Wireless channel, link level design channel access Network design and wireless networks

UNIT –IV **9**

OPTICAL NETWORKS AND SWITCHING

Optical links – WDM systems, cross-connects optical LAN's optical paths and networks TDS and SDS modular switch designs- Packet switching, shared, input and output buffers

LECTURE	TOTAL
45	45

RREFERENCES:

1. Jean warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kanffman, London,2000
2. Leon Gracia, Widjaja, "Communication networks", Tata Mc Graw Hill, New Delhi,2000 3. Lumit Kasera,Pankaj Sethi, "ATM Networks", Tata McGraw Hill, New Delhi,2000
4. Behrouz.a. Forouzan, "Data Communication and Networking", Tata Mc Graw Hill, New Delhi,2004.
5. Itamar Elhanany and Mounir Hamdi, "High-performance Packet Switching Architectures", Springer Publications, 2011.
6. J.F. Kurose & K.W. Ross,"Computer Networking - A top down approach featuring the internet", Pearson education, fifth edition.
7. Nader F.Mir ,Computer and Communication Networks, first edition, 2006.
8. Walrand .J. Varatya, High performance communication network, Margan Kanffman Harcourt Asia Pvt. Ltd. 2nd Edition, 2000.
9. LEOM-GarCIA, WIDJAJA, "Communication networks", TMH seventh reprint 2002. 10. Aunurag kumar, D. MAnjunath, Joy kuri, "Communication Networking", Morgan

SUBCODE	SUB NAME	L	T	P	C
QWC402C	RADAR COMMUNICATION	3	0	0	3

UNIT I **9**

INTRODUCTION TO RADAR

Basic Radar –The simple form of the Radar Equation- Radar Block Diagram- Radar Frequencies –Applications of Radar – The Origins of Radar, The Radar Equation. Introduction- Detection of Signals in Noise- Receiver Noise and the Signal-to-Noise Ratio-Probability Density Functions- Probabilities of Detection and False Alarm- Integration of Radar Pulses- Radar Cross Section of Targets- Radar cross Section Fluctuations- Transmitter Power-Pulse Repetition Frequency- Antenna Parameters-System losses – Other Radar Equation Considerations.

UNIT II **9**

MTI AND PULSE DOPPLER RADAR

Introduction to Doppler and MTI Radar- Delay –Line Cancelers- Staggered Pulse Repetition Frequencies –Doppler Filter Banks - Digital MTI Processing - Moving Target Detector - Limitations to MTI Performance - MTI from a Moving Platform (AMIT) - Pulse Doppler Radar – Other Doppler Radar Topics- Tracking with Radar –Monopulse Tracking – Conical Scan and Sequential Lobing- Limitations to Tracking Accuracy - Low-Angle Tracking - Tracking in Range - Other Tracking Radar Topics -Comparison of Trackers -Automatic Tracking with Surveillance Radars (ADT).

UNIT III **9**

TRANSMITTER AND RECEIVERS

Radar Transmitters- Introduction –Linear Beam Power Tubes - Solid State RF Power Sources - Magnetron - Crossed Field Amplifiers - Other RF Power Sources - Other aspects of Radar Transmitter.Radar Receivers - The Radar Receiver - Receiver noise Figure - Superheterodyne Receiver -Duplexers and Receiver Protectors- Radar Displays.

UNIT IV **9**

DIRECTION FINDING AND RANGE MEASUREMENTS

Introduction - Four methods of Navigation.Radio Direction Finding - The Loop Antenna - Loop Input Circuits - An Aural Null Direction Finder - The Goniometer - Errors in Direction Finding - Adcock Direction Finders - Direction Finding at Very High Frequencies - Automatic Direction Finders - The Commutated Aerial Direction Finder - Range and Accuracy of Direction Finders, Radio Ranges - The LF/MF Four course Radio Range - VHF Omni Directional Range(VOR) - VOR Receiving Equipment - Range and Accuracy of VOR - Recent Developments.

UNIT V **9**

DISTANCE MEASURING, LANDING SYSTEMS AND DOPPLER NAVIGATION

DME and TACAN - Distance Measuring Equipment - Operation of DME - TACAN -TACAN Equipment Aids to Approach and Landing - Instrument Landing System - Ground Controlled Approach System - Microwave Landing System(MLS)

Doppler Navigation - The Doppler Effect - Beam Configurations -Doppler Frequency Equations - Track Stabilization - Doppler Spectrum - Components of the Doppler Navigation System - Doppler range Equation - Accuracy of Doppler Navigation Systems. Inertial Navigation - Principles of Operation - Navigation Over the Earth - Components of an Inertial Navigation System - Earth Coordinate Mechanization - Strapped-Down Systems -Accuracy of Inertial Navigation Systems. Satellite Navigation System - The Transit System - Navstar Global Positioning System (GPS)

LECTURE	TOTAL
45	45

REFERENCES

1. Merrill I. Skolnik ," Introduction to Radar Systems", Tata McGraw-Hill (3rd Edition) 2003
2. Peyton Z. Peebles:, "Radar Principles", Johnwiley, 2004
3. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

SUBCODE	SUB NAME	L	T	P	C
QWC402D	SOFTWARE DEFINED RADIO	3	0	0	3

UNIT I **9**

SOFTWARE BASED RADIO

Software defined radio and Software Radio Concepts – Realization of Software Based Radio - Front end Technology: Radio Frequency Translation and Software Defined Radio: Requirements and Specifications- Receiver Design Considerations- Transmitter Design Considerations- Candidate Architectures for SDR – Radio frequency front end Implementations for Multimode SDRS: Evolution of RF Front Ends – Superheterodyne Architecture- The AS 2/6 Product Family – Dual Band, Six Mode – Alternative RF Front End Architectures.

UNIT II **9**

DATA CONVERSION IN SOFTWARE DEFINED RADIOS:

The Importance of Data Converters in Software Defined Radios-Converter Architectures – Converter Performance Impact on SDR-Superconductor Microelectronics: A Digital RF Technology for Software Radios: Introduction-Rapid Single Flux Quantum Digital Logic – Cryogenic Aspects- Superconductor SDR for Commercial Applications & Military Applications – The Digital Front End: Bridge Between RF and Baseband Processing: The digital front end-Digital up and down conversions-Channel Filtering-Sample Rate Conversion.

UNIT III **9**

BASEBAND TECHNOLOGY:

Baseband Processing for SDR-The Role of Baseband Architectures – Base Band Component Technologies-Design Tools and Methodologies-System design and maintenance – Parameterization-A Technique for SDR Implementation – Definitions-Adaptability – Parameterization of Standards – Signal Processing Issues – Adaptive Computing IC Technology for 3G Software – Software defined Radio – A Solution for Mobile Devices – The Mobile Application Space and the need for Processing Power- SDR Baseband processing – Hardware with Software Programmability – The Computational Power Efficiency Required by 3 G Algorithms – Example Case Studies.

UNIT IV **9**

SOFTWARE TECHNOLOGY

Software Engineering for Software Radios-Overview of Vanu Systems – The Importance of software in software Radio – Software Portability-Commodity PC hardware-Signal Processing software-Control – Software-Performance-Future Directions – Software Download for Mobile Terminals – Downloading Technologies for SDR – Standards for downloading-Seamless Upgrading 'on the FLY' security of download –software Architectures for Download- Future Applications of SDR Downloading.

UNIT V

RECONFIGURATION AND WAVEFORM DESCRIPTION **9**

Protocols and Network Aspects of SDR-Protocol stacks: SAPS vs. Reconfigurability-Approaches to protocol stack reconfiguration – Reconfiguration Management and control – Network support for software radios Conclusions – The Waveform Description Language: The specification problem – WDL overview – FM3TR example – Refinement to an implication – WDL details – A practical WDL support environment.

	LECTURE	TOTAL
	45	45

REFERENCES

1. Walter Tuttlebee, “Software Defined Radio: Enabling Technologies”, Wiley Publications, 2002.
2. Paul Burns, “Software Defined Radio for 3G”, Artech House, 2002
3. Markus Dillinger, “Software Defined Radio: Architectures, Systems and Functions”, 2003.

SUBCODE	SUB NAME	L	T	P	C
QWC402E	QUALITY OF SERVICE IN WIRELESS COMMUNICATION	3	0	0	3

UNIT I — **9**

QOS FOR PACKET NETWORKS-AN INTRODUCTION

Qos of real time services- delay-frame delay-packetization delay-interleaving delay-error correction coding delay-jitter buffer delay-packet queuing delay-propagation delay-effect of delay-end-to-end delay objectives- delay variation or "jitter"- source of delay variation-packet loss probability-subjective testing--mean opinion score (mos)-the "emodel"--codec performance- blocking probability-"trunked channel" systems--offered traffic -oad-units of traffic load-trunk utilization factor

UNIT II — **9**

QOS IN CELLULAR SYSTEMS - PART I

QoS Definition- Need for QoS Differentiation- QoS Standardization -Data Services Classification IP-Based QoS Motivation of IP QoS Mechanisms QoS Paradigms IP-QoS Management in UMTS Networks Traffic Handling Mechanisms. Motivation for QoS in cellular systems- Service Experience -Radio Network Performance- Network Capacity-Network Design- Application Design- Service-Enhancing Technology

UNIT III — **9**

QOS IN CELLULAR SYSTEMS - PART II

QoS Architecture in 3GPP and 3GPP2 End-to-End QoS Introduction Evolution of QoS in 3GPP Releases IP Multimedia Subsystem (IMS)-3GPP versus 3GPP2 in QoS End-User Performance Analysis-Characterization of End-User Performance-Data Link Effects-Transport and Application Layer Effects-Impact of Network Dimensioning in the Service Performance.

UNIT IV — **9**

QUALITY OF SERVICE IN AD HOC NETWORKS

Challenges behind QOS Provisioning in Adhoc networks-Routing in mobile ad hoc networks- Routing with quality of service constraints-Quality of service routing in ad hoc networks

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UNIT V — **9**

QOS IN WIRELESS SENSOR NETWORKS

WSN challenges-Difficulties of QOS provisioning in WSN-QOS Performance metrics in WSN-Mechanisms to Achieve QOS in WSN- Resource Constraints-Platform Heterogeneity-Dynamic Network Topology-Mixed Traffic- Power, bandwidth, meomory size constraints-Application-specific QoS, Network QoS, QoS Aware Communication Protocols-QoS-Aware Power Management

LECTURE	TOTAL
45	45

REFERENCES

Kun I. Park, Ph.D."Qos In Packet Networks"2005 Springer Science Boston 2.Amitabh Mishra "Security And Quality Of Service In Ad Hoc Wireless Networks"Cambridge University Press 2008

3.G. Gómez and R. Sánchez" End-to-End Quality of Service over Cellular Networks" 2005 John Wiley & Sons Ltd

4. Hwee-Xian Tan "Quality of service in wireless sensor networks".

SUBCODE	SUB NAME	L	T	P	C
QWC403A	RF MEMS	3	0	0	3

UNIT I **9**

WIRELESS SYSTEMS

Introduction, spheres of wireless activities, the home and office, the ground fixed/mobile platform, the space platform, wireless standards, systems and architectures, conceptual wireless systems, wireless transceiver wireless appliances enable ubiquitous connectivity.

UNIT II **9**

ELEMENTS OF RF CIRCUIT DESIGN

Physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self-resonance frequency, quality factor packaging, practical aspects of RF circuit design, DC biasing, impedance mismatch effects in RF MEMS.

UNIT III **9**

RF MEMS

RF MEMS, enabled circuit elements and models, RF/microwave substrate properties, micro machined, enhanced elements, capacitors, inductors, varactors, MEM switch, shunt MEM switch, low voltage hinged MEM switch approaches, push-pull series switch, folded-beam springs suspension series switch, resonators- transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustics wave resonators, MEMS modeling- mechanical modeling, electromagnetic modeling.

UNIT IV **9**

NOVEL RF MEMS

Novel RF MEMS, enabled circuits, reconfigurable circuits, the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS micro-switch arrays, reconfigurable circuits, double, stud tuner, Nth-stub tuner, filters, resonator tuning system, massively parallel switchable RF front ends, true delay digital phase shifters, reconfigurable antennas, tunable dipole antennas, tunable microstrip patch-array antenna.

UNIT V **9**

RF MEMS BASED CIRCUIT DESIGN

Phase shifters, fundamentals, X-band RF MEMS phase shifter for phased array applications, Ka-band RF MEMS phase shifter for radar systems applications, Film bulk acoustic wave filters, FBAR filter fundamentals, FBAR filter for PCS applications, RF MEMS filters, A Ka-band millimeter wave Micro machined tunable filter, a High-Q 8 MHz MEM resonators filter, RF MEMS Oscillators- fundamentals, a 14GHz MEM Oscillator, a Ka-Band micro machined cavity oscillator, a 2.4 GHz MEMS based voltage controlled oscillator,design of PLL.

LECTURE	TOTAL
45	45

REFERENCES

1. Hector J. De, Los Santos, “RF MEMS Circuit Design for Wireless Communications”, Artech House, 2002.
2. Vijay K. Varadan, K.J. Vinoy, K.A. Jose, “RF MEMS and their Applications”, John Wiley and Sons, Ltd., 2002.
3. Gabriel M. Rebeiz, “RF MEMS Theory, Design & Technology”, Wiley Interscience, 2002.

SUBCODE	SUB NAME	L	T	P	C
QWC403B	MOBILE SATELLITE COMMUNICATION	3	0	0	3

UNIT I **9**

Introduction to Satellite Communication: Satellite Orbits – Satellite Constellations – Orbital Mechanics – Equation of orbit – Orbital Elements – Look angle determination – orbital perturbation – Satellite coverage – Space environment – Eclipse – Sun Transit outage – Limits of visibility – sub satellite point - launching procedures and Launch Vehicles.

UNIT II **9**

Radio link and satellite access: Spectrum issues – Propagation characteristics and frequency considerations – Radio link analysis – Modulation – coding and multiple access schemes and comparison of multiple access schemes.

UNIT III **9**

Spacecraft Technology: Satellite subsystems – Satellite for MSS, Intersatellite links – Emerging Technologies – Launching Satellite constellation- Gateways – Mobile Terminals – Environmental issues.

UNIT IV **9**

System architecture: System planning – Service Distribution model – Investment Routes – Regulatory issues – Traffic Forecast – Air interface –system development – network considerations and network management – Licensing issues.

UNIT V **9**

Satellite system & services: Representative MSS system – Distress and Safety Systems- navigation systems – Direct Satellite broadcast – Direct TV Broadcast system – Very Small Aperture Terminal systems- Terrestrial Cellular system – Future Trends –Broadband systems – ATM over Satellite – Role of Satellite in Feature Networks.

	LECTURE	TOTAL
	45	45

REFERENCES

1. 1. M.Richharia, “Mobile Satellite Communications-Principles & Trends”, Pearson Education, 2003
2. T.Pratt and Bostian, “Satellite Communications”, John Wiley, 2001.
3. W.L.Prichand and A.Sciulli, “Satellite Communication systems Engineering”, Prentice Hall, 1986
4. T.Ha, “Digital Satellite Communication Systems Engineering”, McGraw Hill, 1998
5. Gerard Maral, Michel Bousquet and Zhili ,“Satellite Communications Systems: Systems,Techniques and Technology”, Wiley, 2010.
6. Anil K. Maini and Varsha Agrawal “Satellite Technology: Principles and Applications”, Wiley, 2010.
7. Bruce R. Elbert "Introduction to Satellite Communication (Artech House Space Applications)”, 2008.

SUBCODE	SUB NAME	L	T	P	C
QWC 403C	REMOTE SENSING AND GIS	3	0	0	3

UNIT I **9**

REMOTE SENSING CONCEPTS

Energy Sources and Radiation Principles – Energy Interactions in the Atmosphere, Earth Surface Features – Data Acquisition and Interpretation – Ideal Remote Sensing System– Real Remote Sensing System Characteristics – Global Positioning System – Across Track Scanning and Operating Principles – Along Track Scanning

UNIT II **9**

IMAGE PROCESSING IN REMOTE SENSING

Image Enhancement – Contrast Manipulation – Spatial Feature Manipulation – Image Classification – Supervised Classification – Classification Stage – Training Stage – Unsupervised Classification – Hybrid Classification – Post Classification Smoothing – Output Stage – Change Detection Techniques.

UNIT III **9**

MICROWAVE REMOTE SENSING AND REMOTE SENSING SATELLITES

Basic feedback topologies, Input and Output resistances with feedback, Analysis of feedback amplifiers, Nyquist criterion for stability of feedback amplifiers, Coil losses, unloaded and loaded Q of tank circuits, small signal tuned amplifiers, Analysis of single tuned and synchronously tuned amplifiers, Instability of tuned amplifiers, Stabilization techniques, Narrow band neutralization using coil, Broad banding using Hazeltine neutralization, Class C tuned amplifiers and their applications.

UNIT IV **9**

GEOGRAPHICAL INFORMATION SYSTEMS

Information Systems Overview – GIS Definitions and Terminology – GIS Queries – GIS Architecture – Theoretical Models of GIS. Spatial Data Modelling: Stages of GIS Data Modelling – Graphic Data Representation of Spatial Data – Raster GIS Models – Vector GIS Models – Comparison of Raster and Vector Data Models

UNIT V **9**

REMOTE SENSING APPLICATIONS

Image Interpretation Elements, Strategies and Keys – Land Use/Land Cover Mapping – Agricultural Applications – Forestry Applications – Water Resource Applications – Urban & Regional Planning Applications – Wetland Mapping – Wild Life Ecology Applications – Archaeological Applications.

LECTURE	TOTAL
45	45

REFERENCES

1. Thomas M.Lillesand, Ralph W.Kiefer, "Remote Sensing and Image Interpretation", Fifth Edition, 2004. (Units I to III & V)
2. M.Anji Reddy, "Remote Sensing and Geographical Information Systems", Second Edition, BS Publications. 2001 (Unit IV)
3. Swain and Davis, "Remote Sensing – The quantitative Approach", McGraw Hill Publications.1997.
4. John R. Jensen, "Remote Sensing of the Environment – An Earth Resource Perspective", Pearson Education Series, 2003.
5. Kang-Tsung Chang, "Introduction to Geographic Information Systems", Tata McGraw-Hill Edition, 2002.

SUBCODE	SUB NAME	L	T	P	C
QWC403D	FREE SPACE OPTICS	3	0	0	3

UNIT I **9**

FUNDAMENTALS

Fundamentals of FSO Technology : Introduction – Maxwell's Equations – Electromagnetic wave propagation in free space - alternate bandwidth technologies – Fiber Vs FSO- Fiber Access – Overview of FSO Optical Transmitters – Receivers – Subsystems – Pointing, Acquisition and Tracking – Line of sight analysis.

UNIT II **9**

FSO NETWORKS

The Role of FSO in the network – factors affecting FSO – line of sight(LOS) – Selecting transmission wave integration of FSO in Optical networks – installation of FSO systems – moving towards edge – and residential areas.

UNIT III **9**

LONG DISTANCE FSO COMMUNICATION

The FSO model – Applications – System descriptions and design – Introduction to Laser Satellite Communications – Characteristics, Modulation Techniques and Radiation effects – Laser Sources.

UNIT IV **9**

PLANE EM WAVES IN ISOTROPIC MEDIA

OPTICAL COMPONENTS FOR FSO

Optical waveguides – Optical Filters, Couplers, Amplifiers, Switches, Antennas, Interconnecting Equipments, etc – Optical integrated circuits – semiconductor integrated optic devices.

UNIT V **9**

OPTICAL SIGNAL PROCESSING

Analog and Discrete systems – Noise and Stochastic processes – Filters – Power spectra estimation – Ambiguity function, Wigner distribution function and triple correlations

LECTURE	TOTAL
45	45

REFERENCES

1. Heinz, Phd. Willebrand, "Free Space Optics", Sams, First Edi. – 2001
2. Morris Katzman, "Laser Satellite Communication", Prentice Hall Inc., New York, 1991. 3. Hiroshi Nishihara, "Optical Integrated Circuits", McGraw Hill, New York, 1992.
4. Pankaj K. Das, "Optical Signal Processing", Narosa Pub. House, 1993.
5. Rajiv Ramaswami, Kumar Sivarajan and Galen Sasaki "Optical Networks: A Practical Perspective", Morgan Kaufmann, 3rd Edition, 2009.

SUBCODE	SUB NAME	L	T	P	C
QWC403E	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	3	0	0	3

UNIT I **9**

BASIC CONCEPTS

Definition of EMI and EMC with examples, Classification of EMI/EMC - CE, RE, CS, RS, Units of Parameters, Sources of EMI, EMI coupling modes - CM and DM, ESD ,Phenomena and effects, Transient phenomena and suppression.

UNIT II **9**

EMI MEASUREMENTS

Basic principles of RE, CE, RS and CS measurements, EMI measuring instruments-

Antennas, LISN, Feed through capacitor, current probe, EMC analyzer and detection technique open area site, shielded anechoic chamber, TEM cell.

UNIT III **9**

EMC STANDARD AND REGULATIONS

National and Intentional standardizing organizations- FCC, CISPR, ANSI, DOD, IEC,

CENEEC, FCC CE and RE standards, CISPR, CE and RE Standards, IEC/EN, CS standards, Frequency assignment - spectrum conversation

UNIT IV **9**

EMI CONTROL METHODS AND FIXES

Shielding, Grounding, Bonding, Filtering, EMI gasket, Isolation transformer, opto isolator.

UNIT V **9**

EMC DESIGN AND INTERCONNECTION TECHNIQUES

Cable routing and connection, Component selection and mounting, PCB design- Trace routing, Impedance control, decoupling, Zoning and grounding

LECTURE	TOTAL
45	45

REFERENCES

1.Prasad Kodali.V – Engineering Electromagnetic Compatibility – S.Chand&Co – New Delhi – 2000

2. Clayton R.Paul – Introduction to Electromagnetic compatibility – John Wiley & Sons – 1992

3. Keiser – Principles of Electromagnetic Compatibility – Artech House – 3rd Edition –1994 4. Donwhite Consultant Incorporate – Handbook of EMI / EMC – Vol I - 1985