Department of Electronics and Communication Engineering

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PERIYAR MANIAMMAI INSTITUTE OF SCIENCE & TECHNOLOGY
PMIST

PERIYAR MANIAMMAI
INSTITUTE OF SCIENCE & TECHNOLOGY
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M.TECH. – WIRELESS COMMUNICATIONS

REGULATIONS 2018

(TWO YEAR FULL TIME)

CURRICULUM AND SYLLABUS

SEMESTER I

	CODE NO.	COURSE TITLE	L	T	P	C	H
PCC	YWC101	Modern Digital Communication	3	0	3	3	3
PCC	YWC102	Wireless Communication	3	0	0	3	3
PCC	YWC103	Wireless Networks	3	0	0	3	3
PEC	YWC104*	Elective I	3	0	0	3	3
PEC	YWC105*	Elective – II	3	0	0	3	3
PCC-L	YWC106	Digital Communication Lab	0	0	1	1	2
MC	YRM107	Research Methodology and IPR	0	0	1	1	2
MC - Audit	YEGOE1	English for Research Paper Writing	2	0	0	0	2
PCC-L	YWC109	Wireless Networks Lab	2	0	0	0	2

Total Hours:23 **Total Credits: 17**

SEMESTER II

	CODE NO.	COURSE TITLE	L	T	P	C	H
PCC	YWC201	Multi Carrier Communication	3	0	0	3	3
PCC	YWC202	Microwave Passive and Active Systems	3	0	0	3	3
PCC	YWC203	Advanced Radiation Systems	3	0	0	3	3
PEC	YWC204*	Elective – III	3	0	0	3	3
PEC	YWC205*	Elective IV	3	0	0	3	3
PCC-L	YWC206	Radio Frequency Systems lab	0	0	1	1	2
PCC-L	YWC207	Mini Project	0	0	1	2	4
MC- Audit	YPSOE1	Constitution of India	2	0	0	0	2

Total Hours: 21 **Total Credits: 18**

SEMESTER III

	CODE NO.	COURSE TITLE	L	T	P	C	H
PCC	YWC301	Dissertation Phase – I	0	0	10	10	20
PEC	YWC302*	Elective -V	0	0	0	3	3
OEC	Open Elective	1. Business Analytics 2. Industrial Safety 3. Operations Research 4. Cost Management of Engineering Projects	3	0	0	3	3

Total Hours: 26 **Total Credits: 16**

SEMESTER IV

	CODE NO.	COURSE TITLE	L	T	P	C	H
PCC	YWC401	Dissertation Phase – II	0	0	16	16	32

Total Hours: 32 **Total Credits: 16**

Overall Credits:68

Legend

PCC – Professional Core Course
PEC- Professional Elective Course
OEC – Open Elective Course
PCC-L – Professional Core Course - Lab

LIST OF ELECTIVES

Sl.No	Code No	Course Title	L	T	P	C
ELECTIVE-I						
1	YWC104A	Radar communication	3	0	0	3
2	YWC104B	Mobile Satellite Communication	3	0	0	3
3	YWC104C	Advanced Digital Signal Processing	3	0	0	3
4	YWC104D	Free space optics	3	0	0	3
ELECTIVE-II						
1	YWC105A	Mathematics for Communication Systems	3	0	0	3
2	YWC105B	RF MEMS	3	0	0	3
3	YWC105C	Antenna Systems for Wireless Applications	3	0	0	3
4	YWC105D	Detection and Estimation Theory	3	0	0	3
ELECTIVE-III						
1	YWC204A	Wireless Network Security	3	0	0	3
2	YWC204B	Adhoc Networks	3	0	0	3
3	YWC 204C	High Performance Computing Networks	3	0	0	3
4	YWC204D	Internet of Things	3	0	0	3
ELECTIVE-IV						
1	YWC205A	Soft Computing	3	0	0	3
2	YWC205B	Multimedia Compression Techniques	3	0	0	3
3	YWC 205C	Software Defined Radio	3	0	0	3
4	YWC205D	Fundamentals of 5G Mobile and Wireless Technology	3	0	0	3
ELECTIVE-V						
1	YWC2302A	Quality of Service in Wireless Communication	3	0	0	3
2	YWC302B	Telecom Network Planning and Management	3	0	0	3
3	YWC 302C	Regulation and Policy in the Telecommunications Industry	3	0	0	3

SUBCODE	SUB NAME	L	T	P	C
YWC101	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**

MIMO I: 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- capacity and multiplexing architectures -The V-BLAST architecture, Fast fading MIMO channel- Receiver architectures

UNIT V **9**

MIMO II: 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

REFERENCES

1. 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. Rappaport T.S., "Wireless Communications; Principles and Practice", Prentice Hall, NJ, 1996.
6. Lee W.C.Y., "Mobile Communications Engineering: Theory and Applications", Second Edition, McGraw-Hill, New York, 1998.
7. Schiller, "Mobile Communications", Pearson Education Asia Ltd., 2000
8. Andrea Goldsmith, Wireless Communications, Cambridge University Press, 2005

SUBCODE	SUB NAME	L	T	P	C
YWC102	MODERN DIGITAL COMMUNICATION	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**

COMMUNICATIONS LINK ANALYSIS

Channel and sources of signal loss, Received Signal Power and Noise Power, Link Budget Analysis, Noise Figure, Noise Temperature, and System Temperature, Sample Link Analysis, Satellite Repeaters

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.

SUBCODE	SUB NAME	L	T	P	C
YWC103	WIRELESS NETWORKS	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..

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.

SUBCODE	SUB NAME	L	T	P	C
YWC106	DIGITAL COMMUNICATION LAB	0	0	1	1
	LIST OF EXPERIMENTS				

1. Demonstrate the theoretical and simulated BER for M-ary PSK MATLAB.
2. Demonstration of theoretical and simulated BER for M- QAM in AWGN using MATLAB
3. Rayleigh fading channel simulation
4. BER for BPSK/QPSK/QAM under Rayleigh channel
5. Single parity: Encoding and Decoding
6. Hamming code: Encoding and Decoding
7. Equalizers
8. Direct Sequence Spread Spectrum
9. Simulation of OFDM IN MATLAB
10. BER performance of BPSK using convolutional code under AWGN channel

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
YWC107	WIRELESS NETWORKS LAB	0	0	1	1
	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
YWC201	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

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.
7. James B. Y. Tsui, "Special Design Topics in Digital Wideband Receivers", Artech House Radar Library, 2009.

SUBCODE	SUB NAME	L	T	P	C
YWC202	MICROWAVE PASSIVE AND ACTIVE SYSTEMS	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. **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 –II **9**

PASSIVE CIRCUIT DESIGN wave guide based Directional coupler, E & H plane Tee junction, hybrid T, isolator, circulator, slotted line section, Frequency meter, Attenuator, microwave Antenna

UNIT III **9**

MICROWAVE INTEGRATED PASSIVE CIRCUITS

Power divider coupler Wilkinson power divider 90 degree Hybrid 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 –IV **9**

MICROWAVE SYSTEMS RF transceiver, Microwave standards, Satellite link, Cellular Communication system, Radar systems

UNIT-V **9**

ACTIVE MICROWAVE CIRCUIT DESIGN

Characteristics of microwave diodes and transistors. Linear and nonlinear behavior and models-Amplifier design; gain and stability, design for noise figure- Noise in microwave circuits; dynamic range and noise sources, equivalent noise temperature,
system noise figure considerations

	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.

SUBCODE	SUB NAME	c	T	P	C
YWC204	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

	LECTURE	TUTORIAL	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
3. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications”, Springer, 2010.
4. Michael B. Steer , “Microwave and RF Design: A Systems Approach”, SciTech Publishing, 2009.
5. Ken Kuang, Franklin Kim and Sean S. Cahill, “RF and Microwave Microelectronics Packaging”, Springer, 2009.
6. R. Jacob Baker, “CMOS Circuit Design, Layout, and Simulation”, 3rd Edition (IEEE Press Series on Microelectronic Systems) , 201

SUBCODE	SUB NAME	L	T	P	C
YWC108	RADIO FREQUENCY SYSTEMS LAB	0	0	1	1

1. Directional coupler
2. Circulator
3. Isolator
4. Attenuator
5. Slotted line bench
6. Microwave horn antenna
7. 2.Directional Simulation of Planar Transmission Lines and matching network
8. Simulation of Microwave Filters
9. Couplers and Power dividers
10. Patch antenna

REFERENCES:

ELECTIVES LIST

SUBCODE	SUB NAME	L	T	P	C
YWC104A	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	TUTORIAL	TOTAL
	45	0	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
YWC104B	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	TUTORIAL	TOTAL
45	0	45

REFERENCES

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
YWC104C	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, 2009.
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. Richard G. Lyons "Understanding Digital Signal Processing" , Prentice Hall, 3rd Edition, 2010
11. Alan V. Oppenheim and Ronald W. Schafer "Discrete-Time Signal Processing" 3rd Edition, Prentice Hall, 2009.

SUBCODE	SUB NAME	L	T	P	C
YWC104D	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	TUTORIAL	TOTAL
45	0	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
YWC105A	APPLIED MATHEMATICS FOR COMMUNICATION SYSTEMS	3	1	0	4

UNIT I **9**

VECTOR SPACES

Vector Spaces, Subspaces, Linearly Independence and dependence, Dimension and Bases, Rank – Nullilty dimension theorem, Inner product spaces, Orthogonality and Gram-Schmidt orthogonalization process, Diagonalization

UNIT II **9**

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. **Matrix Theory -** Some important matrix factorizations – The Cholesky decomposition – QR factorization– Least squares method – Singular value decomposition .

UNIT III **9**

RANDOM VARIABLES AND THEIR DISTRIBUTIONS

Random variables - Probability function – Moments – Moment Generation Function, Characteristic Function, Binomial Distribution, Negative Binomial Distribution, Hypergeometric distribution, Multinomial, Poisson Distributions and Relationship between various Discrete-Type distributions Normal, Log - Normal, Multivariate Normal, Gamma, Exponential, Chi-square, Weibull, Rayleigh distributions. Relationship between continuous distributions.

UNIT IV **9**

STOCHASTIC PROCESSES

Introduction- Classification of stochastic process, Stationary process (SSS and WSS) Stationary process, Ergodic Process, Independent increment Process, Markov Process, Counting Process, Narrow-Band Process, Normal Process, Wiener-Levy Process, Poisson, Bernoulli, Shot noise Process, Autocorrelation Function.

UNIT V **9**

QUEUEING MODELS

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

	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. Michel K. Ochi , "Applied Probability and Stochastic Processes," John Wiley & Sons .ISSN – 0271- 6356, 2008.
5. Kenneth Hoffman, "Linear Algebra", Prentice Hall of India Private Limited, New Delhi. [unit II]
6. Grewal,B.S, Higher Engineering Mathematics, 37th edition, Khanna Publishers,2003. [unit I]

SUBCODE	SUB NAME	L	T	P	C
YWC105B	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	TUTORIAL	TOTAL
45	0	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
YWC 105C	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.

LECTURE	TUTORIAL	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.

SUBCODE	SUB NAME	L	T	P	C
YWC105D	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:
Matched filter detector and its performance; generalized matched filter; detection of 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	TUTORIAL	TOTAL
45	0	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
4. Hall PTR, 1993.
5. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
6. http://nptel.iitm.ac.in/courses.php?disciplineId=117
7. R. G. Gallager, “Principles of Digital Communication”, Cambridge University Press, 2008.
8. Lapidoth, “A Foundation in Digital Communication”, Cambridge, 2009.
9. Weeks Michael, “Digital Signal Processing Using MATLAB and Wavelets”, Firewall Media, 2011.

SUBCODE	SUB NAME	L	T	P	C
YRM107	**RESEARCH METHODOLOGY AND IPR**	**3**	**1**	**0**	**4**

UNIT I	**9**
Meaning of research problem, Sources of research problem, Criteria-Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	
UNIT II	**9**
Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	
UNIT III	**9**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.	
UNIT IV	**9**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	
UNIT V	**9**
New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

REFERENCES

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition, “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall, “Industrial Design”, McGraw Hill, 1992.
6. Niebel, “Product Design”, McGraw Hill, 1974.
7. Asimov, “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008

SUBCODE	SUB NAME	L	T	P	C
YWC204A	**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.

	LECTURE	**TUTORIAL**	**TOTAL**
	45	**15**	**60**

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.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
YWC204B	**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	**TUTORIAL**	**TOTAL**
45	**0**	**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**
YWC204C	**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	TUTORIAL	TOTAL
	45	0	45

REFERENCES:

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

COURSE CODE	COURSE NAME	L	T	P	C
YEC204D	INTERNET OF THINGS	3	0	0	3

UNIT I INTRODUCTION AND ENABLING TECHNOLOGIES IN IOT **9**

IoT, Machine to Machine, Web of Things, Definition- Major components if IoT devices-Control Units-Sensors-Communication Modules-Power Sources Vision- Characteristics - Layered Architecture- Landscape-- IoT Functional View-IoT related Internet Technology-cloud computing-Networks and Communications related to IoT-Processes related to IoT-Data Management related to IoT-Security Privacy and Trust-Devices level energy issues-Standards related to IoT

UNIT II RESOURCE MANAGEMENT IN THE INTERNET OF THINGS **9**

Clustering - Software Agents - Data Synchronization - Clustering Principles in an Internet of Things Architecture - The Role of Context - Design Guidelines -Software Agents for Object – Data Synchronization- Types of Network Architectures - Fundamental Concepts of Agility and Autonomy-Enabling Autonomy and Agility by the Internet of Things-Technical Requirements for Satisfying the New Demands in Production - The Evolution from the RFID-based EPC Network to an Agent based Internet of Things- Agents for the Behaviour of Objects

UNIT III THE ARCHITECTURE, PLATFORMS, SERVICES | **9**

The Layering concepts , IoT Communication Pattern, IoT protocol Architecture, The 6LoWPAN, Platforms - IBM watson-Intel Platform- Carriot Platform- Webnms-device WISE

UNIT IV SCALABLE INTEGRATION FRAMEWORK | **9**

Introduction- IPV6 Potential- IoT6- IPV6 for IoT- Adapting IPV6 to IoT requirement- IoT6 architecture - DigCovery- IoT6 Integration with cloud and EPICS- Enabling Heterogeneous Integration- IoT6 Smart Office use case- Scalability perceptive.

UNIT VIOT APPLICATIONS | **9**

Smart Environments and Smart Space creation - Connected Devices illustration-Industrial IoT-IERC application Domains-Smart Environment Monitoring- Smart Energy - Smart building- Smart Transport and mobility-IoT Smart X applications

	LECTURE	TUTORIAL	PRACTICAL	TOTAL
	45	0	0	45

REFERENCES

1. Ovidiu Vermesan, Peter Friess, “Internet of Things- From Research and Innovation to market Deployment”, River Publishers, 2014.
2. Arshdeep Bahga, Vijay Madisetti Internet of Things: A Hands-On Approach Hardcover – Madisetti Publishers, 2014
3. Samuel Greengard, “The Internet of Things”, MIT Press, 2015.
4. http://postscapes.com/internet-of-things-resources/

SUBCODE	SUB NAME	L	T	P	C
YWC205A	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	**TUTORIAL**	**TOTAL**
	45	**0**	**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, andProgramming 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**
YWC205B	**MULTIMEDIA COMPRESSION TECHNIQUES**	**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	**TUTORIAL**	**TOTAL**
	45	**0**	**60**

REFERENCES

1. Khalid Sayood: Introduction to Data Compression, Morgan Kauffman Harcourt India,2nd
2. Edition, 2000.
3. David Salomon: Data Compression – The Complete Reference, Springer Verlag New YorkInc., 2nd Edition, 2001.
4. Yun Q.Shi, Huifang Sun : Image and Video Compression for Multimedia Engineering -
5. Fundamentals, Algorithms & Standards, CRC press, 2003.
6. Peter Symes : Digital Video Compression, McGraw Hill Pub., 2004. 5. Mark Nelson:
7. Data compression, BPB Publishers, New Delhi,1998.
8. Mark S.Drew, Ze-Nian Li : Fundamentals of Multimedia, PHI, 1 Edition, 2009
9. Watkinson,J : Compression in Video and Audio, Focal press,London.1995.
10. Jan Vozer : Video Compression for Multimedia, AP Profes, NewYork, 1995
11. Andy Beach, "Real World Video Compression", Pearson Education, 2010.
12. Irina Bocharova , "Compression for Multimedia", Cambridge University Press, 2010.
13. Arjuna Marzuki, Ahmad Ismat Bin Abdul Rahim and Mourad Loulou, "Advances in
14. Monolithic Microwave Integrated Circuits: Modeling and Design Technologies", (Premier Reference source), 2011.

SUBCODE	**SUB NAME**	**L**	**T**	**P**	**C**
YWC205C	**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.

9

UNIT II 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.

9

UNIT III 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.

9

UNIT IV 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	TUTORIAL	TOTAL
	45	0	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
YWC205D	FUNDAMENTALS OF 5G MOBILE AND WIRELESS TECHNOLOGY	3	0	0	3

UNIT I **9**

INTRODUCTION

Rationale of 5G: high data volume, twenty-five billion connected devices and wide requirements - 10 pillars of 5G-Requirements and key performance indicators 5G system concept Concept overview Extreme mobile broadband Massive machine-type communication Ultra-reliable machine-type communication - Dynamic radio access network 3- Lean system control plane - Localized contents and traffic flows -Spectrum toolbox -The 5G architecture -High-level requirements for the 5G architecture

UNIT II **9**

MACHINE-TYPE COMMUNICATIONS

Introduction - Use cases and categorization of MTC - MTC requirements -Fundamental techniques for MTC - Data and control for short packets -Non-orthogonal access protocols - Massive MTC - Design principles -Technology components - Summary of mMTC features - Ultra-reliable low-latency MTC - Design principles - Technology components

UNIT III **9**

SMALL CELLS FOR 5G MOBILE NETWORKS

Introduction- What are Small Cells? - WiFi and Femtocells as Candidate Small-Cell Technologies - WiFi and Femto Performance – Indoors vs Outdoors -Capacity Limits and Achievable Gains with Densification - Gains with Multi-Antenna Techniques -Gains with Small Cells - Mobile Data Demand - Approach and Methodology - Demand vs Capacity - Small-Cell Challenges

UNIT IV **9**

THE 5G RADIO-ACCESS TECHNOLOGIES

Access design principles for multi-user communications-Orthogonal multiple-access systems-Spread spectrum multiple-access systems -Capacity limits of multiple-access methods - Multi-carrier with filtering: a new waveform - Filter-bank based multi-carrier - Universal filtered OFDM - Non-orthogonal schemes for efficient multiple access - Non-orthogonal multiple access (NOMA) - Sparse code multiple access (SCMA) - Interleave division multiple access (IDMA) - Radio access for dense deployments - OFDM numerology for small-cell deployments - Small-cell sub-frame structure - Radio access for V2X communication -Medium access control for nodes on the move - Radio access for massive machine-type communication - The massive access problem -Extending access reservation 198
-Direct random access

UNIT V **9**

SECURITY FOR 5G COMMUNICATIONS

Overview of a Potential 5G Communications
System Architecture -Security Issues and Challenges in 5G Communications
Systems - User Equipment - Access Networks -Mobile Operator’s Core Network - External IP Networks
SON Evolution for 5G Mobile Networks -SON in UMTS and LTE -The Need for SON in 5G - Evolution towards Small-Cell Dominant HetNets -Towards a New SON Architecture for 5G -

	LECTURE	TUTORIAL	TOTAL
	45	0	45

REFERENCES

1. Jonathan Rodriguez" Fundamentals of 5G Mobile Networks", John Wiley & Sons, Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, United Kingdom

2. Afif Osseiran, Jose F . Monserrat and Patrick Marsch, "5G Mobile and Wireless Communications Technology" Cambridge University Press, 2016

SUBCODE	SUB NAME	L	T	P	C
YWC302A	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

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	TUTORIAL	TOTAL
45	0	45

REFERENCES

1. 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
YWC302B	TELECOM NETWORK PLANING AND MANEGEMENT	3	0	0	3

UNIT I **9**

OVERVIEW OF NETWORK PLANNING

Evolution of the Telecom context -Requirements to the planners- Typical network planning tasks-Network planning processes-Overall plans per network layer and technology- Solution mapping per scenario-Relation among technical, business and operational plans-Planning issues and trends when reaching NGN

UNIT II **9**

SERVICE DEFINITION AND FORECASTING AND TRAFFIC CHARACTERIZATION

Customer segments-Services definition and characterization. Categories-Services mapping to customer segment-Service forecasting per segment-Service bundling-Service security

Traffic units for service characterization-Reference periods for dimensioning-Traffic aggregation process-Origin/destination of the traffic flows in Local, Metropolitan, Regional, National, Continental and Intercontinental networks- Traffic models.

UNIT III **9**

ECONOMICAL MODELLING AND BUSINESS PLANS

Business planning - Economic modelling for planning- Economic concepts and terms- Economic modelling for services- Cycle life amortization versus modernization -

UNIT IV **9**

NETWORK DESIGN, DIMENSIONING AND OPTIMIZATION

Core Network -Access Network -Basic optimisation methods - Specific Issues of Radio Network Planning-Special issues for rural network

UNIT V **9**

DATA GATHERING

Geographical information for the studied area -Demand of services in relative penetration per customer category -Demand of traffic, usually expressed as traffic matrices-Information for the existing network and infrastructure-Telecommunication equipment characteristics and capabilities-QOS requirements-Economical and Operational data

LECTURE	TUTORIAL	TOTAL
45	0	45

REFERENCES

1. ITU Telecom Network Planning Reference Manual - Draft version 4.1 January 2007
2. Anandalingam, G., Raghavan, S. (Eds.), "Telecommunications Network Design and Management" Springer US, 2003.
3. Thomas G. Robertazzi, "Planning Telecommunication Networks", John Wiley & Sons, Inc.,1998

SUBCODE	SUB NAME	L	T	P	C
YWC302C	REGULATION AND POLICY IN THE TELECOMMUNICATIONS INDUSTRY	3	0	0	3

UNIT I **9**

THE BIG PICTURE: INTRODUCTION TO TELECOMMUNICATIONS REGULATION - Introduction - Technology in Context -. Why Regulate?-Regulatory Organizations- International Frameworks- Looking Ahead - **A LEVEL PLAYING FIELD: REGULATING FOR EFFECTIVE COMPETITION-** Competitive Markets -Sector Regulation and Competition Law - Competition Analysis - Control of Mergers and Acquisitions-Regulating Prices-

UNIT II **9**

GROWING THE MARKET: LICENSING AND AUTHORIZING SERVICES-Introduction-The Trend Towards General Authorization - Licensing Objectives and Types- Competing for Licenses.-Authorization Principles and Procedures-Special Authorization-Situations- Licensing for Convergence - Global Standards Making and Compliance-

GOING MOBILE: MANAGING THE SPECTRUM Introduction - Changing Demands for Spectrum-Planning and Technical Standards -Mechanisms for Assigning and Pricing Spectrum.-Monitoring Spectrum- Flexibility in Spectrum

UNIT III **9**

FROM CAPACITY TO CONNECTIVITY: NETWORK ACCESS AND INTERCONNECTION

Introduction-Access and Interconnection -Forms of Interconnection-Setting Interconnection rices-Cross-border Interconnection-New Paradigms and New Challenges- Dispute Resolution-

UNIT IV **9**

FROM AVAILABILITY TO USE: UNIVERSAL ACCESS AND SERVICE -Trends and Approaches-Policy Rationale-Types of Universal Service Regimes-Reforming Universal Access - Strategies for Developing Economies -Digital Literacy and e-Inclusion -

UNIT V **9**

A DIGITAL FUTURE: REGULATORY CHALLENGES IN A BRAVE NEW WORLD - Convergence, Ubiquity, and Web 2.0 - Regulating Digital Content- Balancing Intellectual Property Rights-. Neutrality of Access- Protecting Privacy- Cybersecurity Concerns - Green ICT-Regulation in a Global Era

LECTURE	TUTORIAL	TOTAL
45	0	45

REFERENCES

1. Colin Blackman and Lara Srivastava, "Telecommunications Regulation Handbook, Tenth Anniversary Edition, The International Bank for Reconstruction and Development / The World Bank, InfoDev, and The International Telecommunication Union, 2011

SUBCODE	SUB NAME	L	T	P	C
YWC206	RADIO FREQUENCY SYSTEMS LAB	0	0	1	1

1. Directional coupler
2. Circulator
3. Isolator
4. Attenuator
5. Slotted line bench
6. Microwave horn antenna
7. Directional Simulation of Planar Transmission Lines and matching network
8. Simulation of Microwave Filters
9. Couplers and Power dividers
10. Patch antenna