SCHOOL
OF
INFORMATION AND COMMUNICATION TECHNOLOGY

COURSE STURCTURE

M. TECH. ICT

SPECIALIZATION:

WIRELESS COMMUNICATION &NETWORKS

GAUTAM BUDDHA UNIVERSITY
GAUTAM BUDH NAGAR, GREATER NOIDA
2014-2015

Annexure 10.6: M.Tech.(ICT) (WCN) (2014-2015) 10th BOS 11/09/2014

SEMESTER- I

Sr.No	Course Code	Courses	L-T-P	Credits
		THEORY		
1	EC535	Digital IC Design	3-1-0	4
2	CS523	Advanced Computer Architecture	3-1-0	4
3	EC531	Advanced Digital Communication System	3-1-0	4
4	CS527	Research Techniques in ICT	3-0-0	3
5	SS101	Human Values & Buddhist Ethics	2-0-0	2
		PRACTICALS		
6	EC585	Digital IC Design Lab	0-0-3	2
7	EC581	Advanced Digital Communication Lab	0-0-3	2
8	GP531	General Proficiency	---	1
		Total	14-3-6	22
		Total Contact Hours	23	

SEMESTER- II

Sr. No.	Course Code	Courses	L-T-P	Credits
		THEORY		
1	MA402	Modeling and Simulation	3-1-0	4
2	EC540	Wireless Networks	3-0-0	3
3	EC534	Wireless System Design	3-0-0	3
4	EC546	Ad-hoc Wireless Networks	3-0-0	3
5		Elective-1	3-0-0	3
		PRACTICALS		
6	EC584	Design Lab-I	0-0-3	2
7	EC592	Major Project	0-0-10	5
8	GP532	General Proficiency	---	1
		Total	**15-1-13**	**24**
		Total Contact Hours	29	

Electives (1)

Sr.No	Course Code	Courses
1	EC562	Optical Networks
2	EC544	Advanced RF Engineering
3	EC550	Advanced Microwave Communication
4	EC542	Advanced Computer Networks
5	EC532	Advanced Communication Networks

Annexure 10.6: M.Tech.(ICT) (WCN) (2014-2015) 10th BOS 11/09/2014

SEMESTER – III

Sr. No.	Course Code	Courses	L-T-P	Credits
		THEORY		
1	EC631	Security in Wireless Networks	3-0-0	3
2	EC635	Mobile Computing	3-0-0	3
3		Elective-2	3-0-0	3
4		Elective-3	3-0-0	3
		PRACTICALS		
5	EC681	Design Lab-II	0-0-3	2
7	EC691	Dissertation Part-I	0-0-14	7
8	GP631	General Proficiency	---	1
		Total	**12-0-17**	**22**
		Total Contact Hours	29	

Electives (2 & 3)

Sr.No	Course Code	Courses
1	EC641	Network Reliability
2	EC643	Smart Antenna Systems
3	EC645	Broadband Wireless Networks
4	EC647	Sensor Networks
5	EC639	Discrete Signal Transformations
6	EC651	Multicast Communication

SEMESTER-IV

Sr. No	Course Code	Courses	L-T-P	Credits
1	EC690	Dissertation Part-II	---	21
2	GP632	General Proficiency	---	1
		Total	**---**	**22**

Grand Total Credits = 90

DIGITAL IC DESIGN			
Course Code:	**EC535**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: Introduction
Digital number systems and information representation; arithmetic operations, decimal and alphanumeric codes, Binary logic, Boolean algebra (identities, functions and manipulation), standard forms, simplification, Logic gates, switch-level and logic CMOS implementation, integrated circuits.

UNIT II: Combinational Logic Design
Components of Combinational Design, Multiplexer and Decoder, Multiplexer Based Design of Combinational Circuits, Implementation of Full Adder using Multiplexer and Decoder, Types of PLD, Combinational Logic Examples, PROM - Fixed AND Array and Programmable OR Array Implementation of Functions using PROM, PLA, PAL, Comparison of PROM, PLA and PAL Implementation of a Function using PAL, Types of PAL Outputs, Device Examples

UNIT III: Sequential Logic Design
Introduction to Sequential Circuits, R-S Latch and Clocked R-S Latch, D Flip Flop, J-K Flip Flop, Master Slave Operation, Edge Triggered Operation, Clocking of Flip-flops, Setup and Hold Times, Moore Circuit, Mealy Circuit Clocking Rules, Sequential Circuits – Design Rules, Sequential Circuit Design Basics, Design of a 4-bit Full Adder using D Flip-flop, Pattern Identifier, State Graph , Transition Table, Implementation of Pattern Identifier, MUX Based Realization, ROM Realization, PAL Implementation

UNIT IV: SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES
PLD families, ROMs, Logic array (PLA), Programmable array logic, GAL, bipolar PLA, NMOS PLA, PAL 14L4, Xilinx logic cell array, I/O Block, Programmable interconnect, Xilinx – 3000 series and 4000 series FPGAs, Altera CPLDs, Altera FLEX 10K series PLDs, Designing a synchronous sequential circuit using PLA/PAL, Realization of finite state machine using PLD

UNIT V: System Design using HDL
HDL operators , Arrays, concurrent and sequential statements , packages, Data flow, Behavioral – structural modeling, compilation and simulation of HDL code, Test bench, Realization of combinational and sequential circuits using HDL, Registers, counters, sequential machine, serial adder , Multiplier-Divider, System Design examples.

Text Books:
[1] Charles H.Roth Jr : Fundamentals of Logic Design, Thomson Learning, 2004
[2] J.Bhaskar: A Verilog Primer, BSP, 2003.
[3] J.Bhaskar: A Verilog HDL Synthesis BSP, 2003

References:
[1] Nripendra N Biswas : Logic Design Theory, Prentice Hall of India,2001
[2] Parag K.Lala: Digital system Design using PLD, B S Publications, 2003
[3] Charles H Roth Jr. : Digital System Design using VHDL, Thomson learning, 2004
[4] Douglas L.Perry : VHDL programming by Example, Tata McGraw Hill, 2006

ADVANCED COMPUTER ARCHITECTURE			
Course Code:	**CS523**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45+15**	**End Sem Exam Hours:**	**3**

UNIT I

Introduction to parallel processing: parallelism in uniprocessor system, basic uniprocessor architecture, parallel processing mechanism, balancing of sub system bandwidth, multiprogramming and time sharing, parallel computer structures, pipeline computers, array computers, multiprocessor systems, dataflow computer concept, architectural classification scheme: multiplicity of instruction-data streams, serial versus parallel processing, parallelism versus pipelining, parallel processing applications, productive modeling simulation, engineering design and automation.

UNIT II

Principles of pipelining and vector processing: pipelining- an overlapped parallelism, principles of linear pipelining, clock period, efficiency, throughput, classification of pipeline processors, general pipeline and reservation tables.

UNIT III

Principles of designing pipeline processors: effect of branching, data buffering and bussing structures, internal forwarding and register tagging, hazard detection and resolution, job sequencing and collision prevention, reservation and latency analysis, collision free scheduling, state diagram, greedy cycle, pipeline schedule optimization, pipeline throughput, pipeline efficiency.

UNIT IV

Structure and algorithm for array processors: SIMD array processor, SIMD computer organization, inter – PE communication, SIMD interconnection network, static versus dynamic networks, cube interconnection network, shuffle-exchange omega networks, parallel algorithms and SIMD matrix multiplication.

UNIT V

Multiprocessor architecture and scheduling: functional structure, loosely coupled and tightly coupled multiprocessor, deterministic scheduling strategy, deterministic scheduling model, control flow versus data flow computer, data flow graphs and languages.

References Books:

1. Kai Hwang, "Advanced Computer Architecture", Tata McGrawHill Edition
2. Kai Hwang and Faye A. Briggs, "Computer Architecture and Parallel Processing", McGraw-Hill International Edition
3. Richard Y. Kain, "Advanced Computer Architecture: a Systems Design", Prentice Hall.
4. James M. Feldman, Charles T. Retter, "Computer architecture: a designer's Text Based on a generic RISC", McGraw-Hill
5. Jurij Silc, Borut Robic, Theo Ungerer, "Processor Architecture: From Dataflow to Superscalar and Beyond", Springer.
6. Hennessy and Patterson, "Computer Architecture: A Quantitative Approach", Elsevier.
7. Dezso and Sima, "Advanced Computer Architecture", Pearson.
8. Quinn, "Parallel Computing: Theory & Practice", TMH.
9. Quinn, "Parallel Programming in C with MPI and Open MP", TMH

ADVANCED DIGTAL COMMUNCIATION SYSTEM			
Course Code:	**EC531**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1T**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Pulse Modulation Analog Signals:- Sampling of Signal, Sampling Theorem for Low Pass and Band Pass Signals, Aliasing, Pulse Amplitude Modulation (PAM), Time Division Multiplexing (TDM), Channel Bandwidth for PAM-TDM Signal, Types of Sampling, Instantaneous, Natural and Flat Top (Mathematical and Spectral Analysis), Aperture Effect, Introduction to Pulse Position and Pulse Duration Modulation.

Unit II: Pulse Code Modulation Digital Signal:- Quantization, Quantization Error, Pulse Code Modulation (PCM), Signal-to-Noise Ratio in PCM, Companding, Data Rate and Bandwidth of Multiplexed PCM Signal, Inter-symbol Interference, Eye Diagram, Line Coding NRZ, RZ, Biphase, Duo Binary Etc ,Differential PCM (DPCM), Delta Modulation (DM), and Adaptive Delta Modulation (ADM), Slope Overload Error ,Granular Noise ,Comparison of various system in terms of Bandwidth and Signal-to-Noise Ratio.

Unit III: Digital Modulation Techniques :- Analysis, Generation and Detection (Block Diagram), Spectrum and Bandwidth of Amplitude Shift Keying (ASK), Binary Phase Shift Keying (BPSK), Differential Phase Shift Keying (DPSK), Offset and Non-offset Quadrature Phase Shift Keying (QPSK), M-ary PSK, Binary Frequency Shift Keying (BFSK), M-ary FSK, Minimum Shift Keying, Quadrature Amplitude Modulation (QAM), Comparison of digital modulation techniques on the basis of probability of error, Matched Filter.

Unit IV: Concept of Probability, Relative Frequency and Probability Conditional Probability and Independent Events, Random Variables, Discrete Random Variables, Cumulative Distribution Function(CDF), Probability Density Function(PDF),Statistical Averages (Means),Chebyshev's Inequality, Central Limit Theorem.

Unit V: Spread Spectrum Modulation: Pseudo random noise sequences, notion of spread spectrum, direct sequence, frequency hopping, processing gain. Convolution codes and Golay codes.

Text Books:

[1] B. Sklar, Digital Communication, Pearson Education.
[2] Tomasi: Advanced Electronics Communication Systems, 6th Edition, PHI

References:

[1] Taub & Schilling, Principles of Communication system, TMH.
[2] Lathi B.P., Modern Analog and Digital Communication systems, Oxford Uni. Press.
[3] Haykin Simon, Digital Communication, Wiley Publication.
[4] Proakis, Digital communication, McGraw Hill
[5] Schaum's Outline series, Analog and Digital Communication.
[6] Singh and Sapre: Communication System, TMH
[7] Couch: Digital and Analog Communication, Pearson Education
[8] David Smith: Digital Transmission Systems, Springer- Macmillan India Ltd

RESEARCH TECHNIQUES IN ICT			
Course Code:	**CS527**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I : Introduction to Research Techniques

Meaning of research, objectives of research, motivation in research, types of research-Introduction to experimental test bed, algorithmic research, simulation research, mathematical modeling approach, characteristics and prerequisites of research, significance of research, research process, Sources of research problem, criteria of identifying the problem, necessity of defining the problem, errors in selecting research problem, technique involved in defining the problem, Report and paper writing

Unit II: Data Analysis and Statistical Techniques

Data and their analyses, quantitative methods and techniques, Measure of central tendency, measures of variation, frequency distribution, analysis of variance methods, identifying the distribution with data, parameter estimation, Goodness-of-Fit tests-Chi-Square test, K-S Goodness-of-Fit test.

Correlation analysis, Regression analysis, time series and forecasting, Introduction to discriminant analysis, factor analysis, cluster analysis, conjoint analysis. Sampling methods, test of hypothesis.

Unit III: Random Numbers and Variates

Properties of random numbers, generation, tests for random numbers, random-variate generation-inverse Transform technique, direct transformation, convolution method, acceptance-rejection technique

Probability distributions functions, Moments, moment generating functions, joint distributions, marginal and conditional distributions, functions of two dimensional random variables

Poisson process-Markovian queues, single and multi server models, Little's formula, steady state analysis

Unit IV: Algorithmic Research

Algorithmic research problems, types of algorithmic research, types of solution procedure, steps of development of algorithm, steps of algorithmic research, design of experiments,

Unit V: Simulation and Soft Computing Techniques

Introduction to soft computing, Artificial neural network, Genetic algorithm, Fuzzy logic and their applications, Tools of soft computing, Need for simulation, types of simulation, simulation language, fitting the problem to simulation study, simulation models, verification of simulation models, calibration and validation of models, Output analysis, introduction to MATLAB, NS2, ANSYS, Cadence

Text Books:

[1] R. Panneerselvam, " Research Methodologies," PHI

[2] Jerry Banks, John S. Carson, Barry.L. Nelson David. M. Nicol, " Discrete-Event System Simulation", Prentice-Hall India

[3] Donald Gross, Carl M. Harris, " Fundamentals of Queueing Theory", 2nd Ed. John Wiley and Sons, New York,

References:

[1] Best John V. and James V Kahn: Research in Education, Wiley eastern, 2005.

[2] Sukhia, S.P., P.V. Mehrotra, and R.N. Mehrotra: Elements of Educational Research, PHI publication, 2003.

[3] K. Setia: Methodology of Research Education, IEEE publication, 2004.

] Kothari, C.R.: Research methodology, Methods and Techniques, 2000.

DIGITAL IC DESIGN LAB			
Course Code:	**EC585**	**Credits:**	**2**
No. of Lab (Hrs/Week):	**3**	**End Sem Exam Hours:**	**3**
Total No. of Lab Sessions:	**10**		

List of Experiments

1. Introduction to Simulation Software Modelsim.
2. Realization of Gates using VHDL (AND, OR, NOT)
3. Realization of Universal Gates using VHDL (NAND,NOR, EX-OR, EX-NOR).
4. Realization of 2 to 4 Decoder using VHDL.
5. Realization of 3 to 8 Encoder using VHDL.
6. Realization of Combinational Design of Multiplexer using VHDL.
7. Realization of Combinational Design of Demultiplexer and Comparator using VHDL.
8. Realization of Functions of Half and Full Adder with different Modeling style using VHDL.
9. Realization of 32 bit ALU using VHDL.
10. Realization of Flip-flops using VHDL (SR,D, JK,T).
11. Realization of a 4-bit binary, BCD counters and any sequence counter with Synchronous Reset.
12. Realization of a 4-bit binary, BCD counters and any sequence counter with Asynchronous Reset.
13. Realization of VHDL code for 7- Segments Display.
14. Realization of VHDL codes to display messages on given LCD panel.
15. Realization of VHDL code to operate a given stepper motor.

ADVANCED DIGITAL COMMUNICATION LAB			
Course Code:	**EC581**	**Credits:**	**2**
No. of Lab (Hrs/Week):	**3**	**End Sem Exam Hours:**	**3**
Total No. of Lab Sessions:	**10**		

List of Experiments

1. To verify the sampling theorem.
2. To study ASK (Amplitude Shift Keying) System.
   - Modulate a digital signal using amplitude shift keying.
   - Demodulate a amplitude shift keyed signal.
3. To study FSK (Frequency Shift Keying) System.
   - Modulate a digital signal using frequency shift keying.
   - Demodulate a frequency shift keyed signal.
4. To study BFSK (Binary Frequency Shift Keying) System.
   - Modulate a digital signal using Binary Frequency shift keying.
   - Demodulate a Binary Frequency Shift keyed signal.
5. To study PSK (Phase Shift Keying) System.
   - Modulate a digital signal using phase shift keying.
   - Demodulate a phase shift keyed signal.
6. To study BPSK (Binary Phase Shift Keying) System.
   - Modulate a digital signal using binary phase shift keying.
   - Demodulate a binary phase shift keyed signal.
7. To study QPSK (Quadrature Phase Shift Keying) System.
   - Modulate a digital signal using Quadrature phase shift keying.
   - Demodulate a Quadrature phase shift keyed signal.
8. To study DPSK (Differential Phase Shift Keying) System.
   - Modulate a digital signal using differential phase shift keying.
   - Demodulate a differential phase shift keyed signal.
9. To study Pulse Code Modulation System (PCM) System.
   - Generate, modulate and transmit a pulse coded signal.
   - Receive and demodulate a pulse coded signal.
10. To study TDM (Time Division Multiplexing) System.
    - Generate and transmit a TDM signal.
    - Receive and de-multiplex a TDM signal.
11. To study M-ARY FSK modulation and demodulation.
12. To study and implement the cyclic redundancy check.
13. To study the circuit of PAM modulator and demodulator.
14. To study the circuit of PWM modulator and demodulator.
15. To study the circuit of PPM modulator and demodulator.

WIRELESS NETWORKS			
Course Code:	**EC540**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1T**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Cellular fundaments, SIR calculation, capacity enhancement techniques, channel allocation schemes, handover, path loss modeling, multipath, channel measurements, simulation of radio channels cellular wireless networks-2G TDMA, 2G-CDMA, 3G systems, cordless systems, , IMT 2000, UMTS, CDMA2000, All-IP based cellular networks, WLL, Mobile data networks-CDPD, GPRS

Unit II: Multiple access techniques-TDMA, FDMA, spread spectrum technology-DS-SS, FH-SS, code division multiple access, generation of spreading sequences, SDMA, packet radio- protocols, CSMA protocols, reservation protocols

Unit III: Wireless LAN: evolution of WLAN, IEEE802.11 Physical layer, MAC layer, IEEE 802.11(a,b,e,f,g,h,i) Wireless routing protocols, Mobile IP, IPv4, IPv6, wireless TCP, TCP performance over wireless links, protocols for 3G and 4G networks, Integration of voice and data, VoIP applications

Unit III: WPAN and Geo-location systems: IEEE 802.15 WPAN, wireless geo-location technologies, geo-location standards channel coding, delay, cross layer techniques, .mobility management, radio resources and power management, mobility models, Satellite communication-parameters and configurations, capacity allocation,

Unit-IV: Bluetooth-overview, radio specifications, baseband specifications, link manager specifications, logical ink control and adaptation protocol, iEEE802.15, Design of wireless modem, power efficiency, out of band radiation, UWB pulse transmission

Unit V: Issues in wireless networks-security and privacy issues, authentication in mobile networks, power management, energy awareness computing

Text Books:

[1] William Stallings, " Wireless communications and Networks," "PHI
[2] Kaveh Pahlavan, Prashant Krishnamurthy, " Principles of Wireless Networks" Perason eduction 2002
[3] Theodore S. Rappaport, " Wireless Communication, Principles and Practice, PHI

WIRELESS SYSTEM DESIGN			
Course Code:	**EC404/EC534**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit-I: RF system design procedures, methodology, link budget, propagation models, tower-top amplifiers, RF design guidelines, traffic projections, cell site design.

Unit-II: Network design- traffic forecasts, node dimensioning, interface design, placement of network nodes, topology.

Unit-III: Antenna systems,-base station antenna, cross pole antenna, dual band antenna, intelligent antenna, diversity techniques-derivation of selection diversity and maximal ratio combining improvement, polarization diversity, frequency diversity, time diversity, RAKE receiver. Communication sites-types, installation, towers, stealth, in-building and tunnel systems, inter, modulation, collocation.

Unit-IV: UMTS system design-design principles, coverage analysis, capacity analysis, radio access networks, overlaiding UMTS over GSM, CDMA system design-design methodology, deployment guidelines, traffic estimation, radio elements, fixed network d4sign requirements, traffic models, link budget, case studies-CDAM2000 1xRTT, EVDO, CDMA2000 1xRTT with EVDO overlay

Unit-V: Simulation of Wireless network systems-discrete event simulation, simulation models, performance evaluation and analysis of IEEE802.11 WLAN. Study of various network simulators, GloMoSim, ns-2, Opnet, design and performance evaluation of transport and routing protocols of mobile and wireless networks.

Text Books:

[1] Clint Smith, P.E. Daniel Collins, " 3G Wireless Networks" Tata McGraw-Hill, 2nd Edition
[2] Theodore S. Rappaport, " Wireless Communication, Principles and Practice" Pearson

[3] P. Nicopolitidis, M.S. Obaidat, G.I. Papadimitriou, A.S. Pomportsis, " Wireless Networks", John Wiley & Sons,

References:

IEEE Journals and proceedings

ADVANCED COMMUNCIATION NETWORKS			
Course Code:	**EC402/EC532**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Digital switching systems-analysis, hierarchy, evolution, SPC, call processing, communication and control- level 1,2,& 3 control, interface control, network control processor, central processor, control architecture, multiplexed highways, switching fabric-space division switching, time division switching, STS, TST, TTT, switching system software-architecture, OS, database management

Unit II: MPLS-label stack and label distribution, traffic engineering, design of switching systems, and routers, switching networks-crossbar switches, multistage switches, shared memory switches, optical networks, DWDM techniques, IP over optical core switches

Unit III: Congestion control: integrated services, differentiated services, congestion control, congestion control in packet switching, frame relay congestion control, flow control at link level, TCP congestion control

Unit IV: Voice over IP: basic IP telephone system, digital voice sampling, compression techniques, protocol for VoIP, session initiation protocol

Unit V: Internetworking-connection mode network service, x.75 internetworking, network through ISDN, internetworking SNA, and x.25, x.300 internetworking standards, personal computer networking, data transmission in PTN, Data network standards, voice-data integration, fast packet switches

Text books:

[1] Syed R. Ali, " Digital Switching Systems, System Reliability and analysis, Tata McGraw-Hill
[2] William Stallings, " High Speed Networks and Internet" 2nd ed. Perason edu, 2005
[3] Bellamy John, " Digital Telephony" Wiley 3rd Ed, 2000
[4] Viswanathan, T, "Telecommunications Switching Systems and Networks, " PH

References:

[1] Andrew S. Tanenbaum: Computer networks, PHI.
[2] W. Stallings: Data and computer communications, MC, Milan.
[3] Alberto Leon-Gercia, India Widjaja: Communication networks, fundamental concepts and key architecture, TATA McGraw Hill.
[4] Bertsekas D. and Gallager R.: Data Networks, PHI.
[5] Keshav S: An Engineering Approach to computer Networking, Addison Weslay.

OPTICAL NETWORKS			
Course Code:	**EC562**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: FIBER OPTIC GUIDES

Light wave generation systems, system components, optical fibers, SI, GI fibers, modes, Dispersion in fibers, limitations due to dispersion, Fiber loss, non linear effects, Dispersion shifted and Dispersion flattened fibers

UNIT II: OPTICAL SOURCES AND DETECTORS

Basic concepts, LED's structures spectral distribution, semiconductor lasers, gain coefficients, modes, SLM and STM operation, Transmitter design, Receiver PIN and APD diodes design, noise sensitivity and degradation, Receiver amplifier design. Basic concepts, Semiconductor laser amplifiers, Raman - and Brillouin - fiber amplifiers, Erbium doped – fiber amplifiers, pumping phenomenon, LAN and cascaded in-line amplifiers.

UNIT III: POWER LAUNCHING AND COUPLING

Output patterns, Power coupling, Power launching, Equilibrium Numerical Aperture, Laser diode to fiber coupling, LED coupling to single mode fibre, Fiber Splicing techniques, splicing single mode fibers. Multimode fiber joints and single mode fiber joints, Fibre alignment and joint loss.

UNIT IV: OPTICAL NETWORKS

Point-to- point links, System considerations, Link considerations, Overall fiber dispersion in multi mode and single mode fibers, Rise time considerations, Distance consideration in optical transmission system, Network topologies, SONET/SDH, Protection in SONET/SDH, WDM Principles, WDM networks, DWDM systems

UNIT V: ACCESS NETWORKS

Network Architecture overview, Enhanced HFC, Fiber to the curb, PON Evolution, Optical Code Division Multiplexing, Line coding in Optical links, Soliton communication system, photonics, High Speed Networks.

Text Books:

[1] Rajiv Ramaswami , "Optical Networks" Third Edition , 2008.
[2] Djafar K Mynbaev, Lowell L Scheiner , "Fiber- Optic Communications Technology" , 2000.
[3] Keiser G, "Optical Fiber communications", Second edition, McGrawhill. Inc., 1993.

REFERENCES:

[1] Biswas Sambhu Nath, "Optoelectronic Engineering", Dhanpat Rai Publication1994.
[2] Gowar J., Optical Communication Systems, PHI.
[3] Senior, J M, "Optical Communication Principle and Practices", II edition Pearson Education Ltd, 2006.

ADVANCED RF ENGINEERING			
Course Code:	**EC412/EC544**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: INTRODUCTION TO RF ELECTRONICS

Introduction to RF Design and Wireless Technology: Design and Applications,

Unit II: COMPLEXITY AND CHOICE OF TECHNOLOGY

Basic concepts in RF design: Nonlinearly and Time Variance, Inter symbol interference, random processes and noise. Sensitivity and dynamic range, conversion of gains and distortion

Unit III: RF MODULATION

Analog and digital modulation of RF circuits, Comparison of various techniques for power efficiency, Coherent and non-coherent detection, Mobile RF communication and basics of Multiple Access techniques. Receiver and Transmitter architectures, direct conversion and two-step transmitters. RF Testing: RF testing for heterodyne, Homodyne, Image reject, Direct IF and sub sampled receivers.

Unit IV: BJT AND MOSFET BEHAVIOR AT RF FREQUENCIES

BJT and MOSFET behavior at RF frequencies, modeling of the transistors and SPICE model, Noise performance and limitations of devices, integrated parasitic elements at high frequencies and their monolithic implementation Overview of RF Filter design, Active RF components & modeling,

Unit V: RF CIRCUITS DESIGN

Matching and Biasing Networks. Basic blocks in RF systems and their VLSI implementation, Low noise Amplifier design in various technologies, Design of Mixers at GHz frequency range, Various mixers- working and implementation. Oscillators- Basic topologies VCO and definition of phase noise, Noise power and trade off. Resonator VCO designs, Quadrature and single sideband generators. Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers, Power Amplifier design, Liberalization techniques, Design issues in integrated RF filters.

Text Books :

[1] B. Razavi, "RF Microelectronics" PHI 1998
[2] R. Jacob Baker, H.W. Li, D.E. Boyce "CMOS Circuit Design, layout and Simulation", PHI 1998.

References:

[1] Thomas H. Lee "Design of CMOS RF Integrated Circuits" Cambridge University press 1998.
[2] Y.P. Tsividis, "Mixed Analog and Digital Devices and Technology", TMH 1996
[3] David M. POZAR: Microwave Engineering. - John Wiley & Sons - 2nd Edition (2003).

ADVANCED MICROWAVE COMMUNICATION			
Course Code:	**EC426/EC550**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Microwave And Millimeter Wave Devices

Overview of microwave and millimeter wave vacuum tube devices, limitations of microwave vacuum tubes, gyratron vacuum tube devices. Advances in microwave and millimeter wave solid state devices, Gunn devices, oscillator using, Gunn diode, and injection locked oscillators, IMPATT devices, and microwave and mm wave performance of IMPATT. Other solid state devices like Tunnel diode, BARITT and TRAPAT. Microwave and mm wave circuits:

Unit II: Microwave and MM Wave Circuits

Review of scattering matrix concept in the light of vector network analyzer, impedance matching network, couplers, power dividers, resonators and filters. Detectors, mixers, attenuators, phase shifters, amplifier and oscillator, Ferrite based circuits.

Unit III: Antennas

Hertzian dipole, loop antenna, helical antenna, frequency independent antenna: Du0Hamel principle, log spiral and log periodic dipole antenna array. Babinet principle, waveguide slot antenna, microstrip antenna, horn antenna, parabolic reflector. Antenna arrays and phased array antenna.

Unit IV: Satellite Communication

Orbital parameters, satellite trajectory, period, geostationary satellites, non-geostationary constellations. Communication satellites – Space craft subsystems, payload – repeater, antenna, attitude and control systems, telemetry, tracking and command, power sub system and thermal control. Earth stations antenna and feed systems, satellite tracking system, amplifiers, fixed and mobile satellite service earth stations. Terrestrial: line of sight transmission, relay towers and distance considerations. Communication link design: Frequency bands used, antenna parameters, transmission equations, noise considerations, link design, propagation characteristics of fixed and mobile satellite links, channel modeling, very small aperture terminals (VSAT), VSAT design issues.

Unit V: Microwave and MM Wave Propagation.

Overview of basic radio wave propagation mechanisms, Friis transmission formula, plane earth propagation model, troposcatter systems, ionosphere propagation, duct propagation, microwave radio link and calculation of link budget. Effect on radio wave propagation due to rain, fog, snow, ice, atmospheric gases, Earth's magnetic field.

Text Books:

[1] David M Pozar, Microwave Engineering, John Wiley & Sons
[2] R E Collin, Antenna & Radio wave Propagation, McGraw Hill Book Co.

References:

[1] M Richharia: 'Satellite Communication Systems'.(Second Ed.),Macmillan Press Ltd.
[2] Ferdo Ivanek (Editor): 'Terrestrial Digital Microwave Communications', Artech House
[3] E. Hund: 'Microwave Communications', IEEE Press
[4] Jordan & Balman, Electromagnetic waves & Radiating System
[5] R E Collin, Microwave Engineering, McGraw Hill CO.

ADVANCED COMPUTER NETWORKS			
Course Code:	**EC542**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Principles Of Computer Communications

Introduction to data communications and networks, protocol architecture, networking protocols, reference models, TCP/IP and OSI model, standards organizations, data transmission signal propagation, bandwidth of a signal and a medium; data transmission rate and bandwidth, modes of data transmission, guided media and wireless transmission, multiplexing; types of multiplexing; FDM vs. TDM, switching.

Unit II: Data Link and Network Layer Issues

Design issues in data link and network layers, framing, error control, flow control, sliding window protocols, Medium Access Control Sub layer (MACS), Multiple access Ethernet, Wireless LAN, factors affecting routing algorithms, routing algorithm.

Unit III: Advanced Internetworking and Mobility

Internetworking, addressing, routing and routing algorithms, congestion control algorithms, IPv4, ICMP, ARP, IPv6 and ICMPv6 extensions and functionality, mobile IP, service integration and quality of service (QoS) in IP networks.

Unit IV: Advanced Transport Issues and Signaling

Transport services, element of transport protocols, TCP and UDP, RTP, performance issues, congestion control and QoS, techniques to improve QoS, integrated services, signaling for multi-constrained services and applications.

Unit V: Self Organizing Networks

Introduction to Adhoc, sensor and mesh networks, routing in these networks, socket programming, SMTP, HTTP, Remote login, DNS, FTP.

Text Books:

[1] S. Tanenbaum, Computer Networks, 4th edition, Prentice Hall, 2008.
[2] W. Stallings," Data and Computer Communications, 8th edition, Prentice Hall, 2007.
[3] Forouzan,",Data Communications and Networking," 4th edition, McGraw Hill, 2007.

Reference:

[1] B.A. Forouzan," TCP/IP Protocol Suite", TMH, 3rd edition, 2006.
[2] Jochen H. Schiller, "Mobile Communications," Pearson Education, 2003.
[3] H. Soliman, :Mobile IPv6 - Mobility in a Wireless Internet, Addison-Wesley, 2004.
[4] Douglus E. Comer, "TCP/IP Principles, Protocols and Architecture", Pearson Education.

AD-HOC WIRELESS NETWORKS			
Course Code:	**EC513/EC546**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I : Introduction to Wireless Communication

Electromagnetic spectrum, radio propagation mechanisms, characteristics of the wireless channel, modulation techniques, multiple access techniques, voice coding, error control, computer network software, computer network architecture, IEEE 802 networking standards, wireless networks, issues in ad hoc wireless networks, Ad Hoc, wireless Internet.

Unit II: MAC Protocols For Wireless Networks

Issues in designing a MAC protocol for ad hoc wireless networks, design goals of a MAC protocol for ad hoc wireless networks, classifications of MAC protocols, contention-based protocols, contention-based protocols with reservation mechanisms, contention-based MAC protocols with scheduling mechanisms.

Routing Protocols for Ad Hoc Wireless Network

Issues in designing a routing protocol for ad hoc wireless networks, classifications of routing protocols, table-driven routing protocols, on-demand routing protocols, hybrid routing protocols, routing protocols with efficient flooding mechanisms, hierarchical routing protocols, power-aware routing protocols.

Unit III: Multicast Routing In Ad Hoc Wireless Networks

Issues in designing a multicast routing protocol, operation of multicast routing protocol, an architecture reference model for multicast routing protocol, classifications of multicast routing protocol, tree based multicast routing protocol, mesh-based multicast routing protocol, energy-efficient multicasting, multicasting with QoS guarantees, application- dependent multicast routing.

Unit IV: Transport Layer And Security Protocols For Ad Hoc Wireless Networks

issues in designing a transport layer protocol for ad hoc wireless networks, design goals of a transport layer protocol, classification of transport layer solutions, TCP over ad hoc wireless networks, other transport layer protocol for ad hoc wireless networks, security in ad hoc wireless networks, network security requirements, issues and challenges in security provisioning, network security attacks, key management, secure routing in ad hoc wireless networks.

Unit V: Quality of Service In Ad Hoc Wireless Networks

Issues and challenges in providing QoS in ad hoc wireless networks, classifications of QoS solutions, MAC layer solutions, network layer solutions, QoS frameworks for ad hoc wireless networks. energy management in ad hoc wireless networks, need for energy management in ad hoc wireless networks, classification of energy management schemes, battery management schemes, transmission power management schemes, system power management schemes.

Text Books:

[1] C. Siva Ram Murthy, B.S. Anoj, "Ad Hoc Wireless Networks, Architectures and Protocols", Prentice Hall, 2004.

[2] C. K. Toh, "Ad Hoc Mobile Wireless Networks 1/e: Protocols and Systems, "PH PTR, 2001.

References:

[1] Hekmat Ramin,"Ad-hoc Networks: Fundamental Properties and Network Topologies", Springer Publication.

[2] Mohammad IIyas, "The Handbook of Ad Hoc Wireless Networks", CRC Press

SECURITY IN WIRELESS NETWORKS			
Course Code:	**EC501/EC631**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Security goals, attacks, services and mechanisms, cryptography and steganography

Unit II: Symmetric key ciphers-substitution ciphers, transposition ciphers, stream and block ciphers, algebraic structures and GF (2^n) fields in cryptography

Unit III: Modern block ciphers, modern stream ciphers, DES and AES, Elliptic curve cryptosystems

Unit IV: Message integrity, random oracle model, message authentication , Hash function, Integrity authentication , Digital signature- process, services, attacks, schemes, key management-symmetric key distribution, kerbros, symmetric key agreement, public key distribution

Unit V: Security in wireless LAN, IEEE802.11 security, eavesdropping, unauthorized access, interference and jamming, physical threats, counter majors, WEP, encryption, authentication, WPA, authorization, non repudiation, authentication and secure session, security architecture, VPN, wireless access to the Internet

Text book

[1] Behrouz A. Forouzan, " Cryptography & Network Security" Tata McGraw Hill

MOBILE COMPUTING			
Course Code:	**EC416/EC635**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Mobile Computing Architecture
Introduction to Mobile Communications and Computing : novel applications, limitations, and architecture. GSM: Mobile services, System architecture, Radio interface, Protocols, Localization and calling, Handover, Security, and New data services.

Unit II: Client Programming
Desktop vs. mobile, hardware overview, mobile phones, PDA, design constraints in applications for handheld devices.

Unit III: Programming For the Palm OS
History of palm OS, palm OS architecture, application development, communication in palm OS, multimedia, and enhancements in the current release. Wireless devices with symbian OS; Introduction to Symbian OS, Symbian OS architecture, application for Symbian, control and compounds controls, active objects, localization, security on the Symbian OS, different flavors of windows CE, windows CE architecture, windows CE development environment.

Unit IV: Wireless Application Protocol (WAP)
Overview of the WAP, component of the WAP standards, protocol architecture, and treatment of protocols of all layers, services supporting WAP client, WAP architecture design principle, Bluetooth,J2ME.

Unit V: Special Topics in Mobile Computing
Mobile agent & its application, mobile data management, security framework for mobile environment, m-commerce: emerging applications, different players in m-commerce, m-commerce life cycle, mobile financial services, mobile entertainment services, and proactive service management.

Text Books:
[1] Mobile Computing, Asoke. K Talukder and Roopa R. Yavagal, TMH, 2005
[2] Mobile Communication, Jachan Schiller, Adison-Wesley, 2nd edition, 2003.

References:

[1]Wireless Communication: T. S. Rappapost, Peasson Education, New Delhi, 2001
[2] Wireless Networks: Kareh Pallavan & P. Krishnamurthy, Peasson Education, New Delhi, 2nd edition, 2004.
[3] Mobile Commerce and Applications, Upkar Varshney, A tutorial at IEEE International Conference on Wireless Communications (WCNC), 1999.

NETWORK RELIABILITY			
Course Code:	**EC505/EC641**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Reliability Fundamentals

Causes of Failures, Useful Life of Components, Hazard Functions, Bathtub Curve, Characteristic Type of Failures: Early Failures, Constant Failure Rate, Wear-Out Failures, Failure Data Analysis, Mean Time to Failure (MTTF), Mean Residual Life (MRL), Reliability Measures

Unit II: Reliability Mathematics

Classical Set Theory, Boolean algebra, Sample Space, Probability Theory, Bayes Theorem, Probability Distributions, Cumulative Distributions, Variance, Moments, Estimation Theory, Laplace Transform, Markov Processes, Random Number Generation, Probability Plots

Unit III: System Reliability Analysis

Reliability Block Diagrams, Series Systems, Series Parallel Systems, Open and short Circuit Failures, Standby Systems, System Modeling, Assumptions for Modeling, Two State Modeling, Three State Models, Statistical Estimation of Failure Data, Interval Estimates, Hazard Models.

Unit IV: Reliability Modeling

Stress-Strength Model, System Modeling, Assumptions for Modeling, Two State Modeling, Three-state Modeling, Graphical Approach, Path Set/Cut Set Approach: Inclusion-Exclusion Method, Calculation of Bounds Method, Monte Carlo Simulation Method, Domination Theory, Sum of Disjoint Product Method, Non-path Set/cut Set approach: State Enumeration Method Transformation Method Topological Method BDD/OBDD/ROBDD Method, Reliability Measures: Connectivity Measures, Multicommdity Flow Measures, Maximum Flow (Capacity) Measures, Performability Measures.

Unit V: Maintability and Availablity Analysis

Availability Prediction, Effects of Repair Strategies, Fault Trees, Event Tree Analysis, FMEA, FMECA, Theoretical and Analytical Overview of Availability and Maintainability in Communication System Design: Prediction in Assessment, Preliminary in Design, Evaluation in Detail Design. Application Modeling of Availability and Maintainability in Engineering Design

Text Books:

[1] Aggarwal K. K., Reliability Engineering, Kluwer Academic Publishers, Boston Publication
[2] Ramakumar R., Reliability Engineering: Fundamentals and Applications, Prentice Hall

Reference Books:

[1] Misra K. B., Reliability Analysis and Prediction: A Methodology Oriented Treatment, Elsevier Publication
[2] Kapur K. C. and L. R. Lamberson, Reliability in Engineering Design, John Wiley & Sons,
[3] Martin L Shooman, Reliability of Computer Systems and Networks, Johan Wiley Sons
[4] Naikan V.N.A., Reliability Engineering and life testing, PHI 2010.

SMART ANTENNA SYSTEMS			
Course Code:	**EC507/EC643**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Basic Concepts of Radiation

Radiation mechanism: Basic sources of Radiation- Current distribution on antennas, Basic antenna parameters.

Unit II: Analysis And Synthesis of Antennas

Vector potential, Antenna theorems and definitions, dipole, loop, reflector, slot antennas. Types of linear arrays, current distribution in linear arrays, Antenna array synthesis techniques.

Unit III: Smart Antennas

Spatial processing for wireless systems: Introduction, Vector channel impulse response & the spatial signature. Spatial processing receivers, fixed beam forming Networks, switched beam systems, Adaptive antenna systems, Wide band smart antennas, Digital radio receiver & software radio for smart antennas.

Unit IV: Smart Antenna Techniques for CDMA

Non-coherent & coherent CDMA spatial processors, spatial processing rake receiver, Multi-user spatial processing, dynamic resectoring, down link beam forming for CDMA, MIMO.

Unit V: Micro Strip Antenna

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

Text Books:

[1] Balanis A., "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 1982.

[2] Joseph C. Liberti, Theodore S. Rappaport – "Smart Antennas for Wireless Communications: IS95 and third generation CDMA Applications", Prentice Hall, Communications Engineering and Emerging Technologies Series.

References:

[1] Kraus J.D., "Antennas", II edition, John Wiley and Sons, New York, 1977.

[2] Collin R.E. and Zucker F. – "Antenna theory" Part I, Tata Mc Graw Hill, New York, 1969.

[3] I.J. Bahl and P. Bhartia," Microstrip Antennas",Artech House,Inc.,1980

[4] W.L.Stutzman and G.A.Thiele,"Antenna Theory and Design", 2nd edition,John Wiley& Sons Inc.,1998.

BRAODBAND WIRELESS NETWORKS			
Course Code:	**EC509/EC645**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Introduction to broadband wireless, fixed broadband wireless, mobile broadband wireless, 3G cellular systems, spectrum options for BW, BW channels, fading, modeling of broadband fading channels, mitigation of fading

Unit II:OFDM-basics, timing and frequency synchronization, PAR computational complexity, simulation of OFDM systems, , MAC layer, performance enhancement, architecture, performance characterization, Multiple antenna techniques-spatial diversity, receiver diversity, transmit diversity, beam foaming, spatial multiplexing, channel estimation for MIMO-OFDM, advanced techniques for MIMO,OFDMA in WiMAX

Unit III: WiMAX, Physical layer- channel coding, hybrid ARQ, interleaving, symbol mapping, symbol structure, sub channel and subcarrier permutations, slot and frame structure, ranging power control, channel quality measurements, MAC layer-convergence SL, MAC PDU, bandwidth request, and allocation, QoS, network entry, an initialization, power saving, mobility management

Unit IV: WiMAX network architecture- design principle, reference model, protocol layering, network discovery and selection, IP address assignment, authentication and security, QoS architecture, mobility management, radio resource management, link level performance-methodology, AWGN channel performance, fading channel performance, advanced receiver architecture, system level architecture-channel modeling, methodology, system level simulation,

Unit V: Ultrawideband, Unlicensed wireless access, IEEE 802.20 MBWA, FOMA, iMODE, WiBRO, FWA, AWS, Multimedia-MedaiFLO, T-DBM, DVB-H, MVNO

Text Books:

[1] Jeffrey G. Andrews, Arunabha Ghosh, Rias Muhamed, " Fundamentals of WiMAX, Understanding Broadband Wireless Networking", Pearson

[2] Clint Smith, P.E. Daniel Collins, " 3G Wireless Networks" Tata McGraw-Hill, 2nd Edition

SENSOR NETWORKS			
Course Code:	**EC511/EC647**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Sensor Network Operations

Overview of mission-oriented sensor networks, trends in sensor development, mission oriented sensor networks, dynamic systems perspective, Dense sensor networks, robust sensor positioning in wireless ad hoc sensor networks, trigonometric k clustering (TKC) for censored distance estimation, sensing coverage and breach paths in surveillance wireless sensor networks.

Unit II: Lower Layer Issues-Mac, Scheduling, And Transmission

Medium access control for sensor networks, comprehensive performance study of IEEE 802.15.4, providing energy efficiency for wireless sensor networks, link adaptation techniques.

Unit III: Network Routing

Load balanced query protocols for wireless sensor networks, energy efficient and MAC aware routing for data aggregation in sensor networks, ESS low energy security solution for large-scale sensor networks based on tree ripple zone routing scheme.

Unit IV: Sensor Network Applications

Evader centric program, Pursuer centric program, hybrid pursuer evader program, efficient version of hybrid program, Implementation and simulation results

Unit V: Embedded Soft Sensing For Anomaly Detection

Mobile robot simulation setup, software anomalies in mobile robotic networks, soft sensor, software anomaly detection architecture, anomaly detection mechanisms, test bed for software anomaly detection in mobile robot application, multisensor network-based framework; Basic model of distributed multi sensor surveillance system, super resolution imaging, optical flow computation, super resolution image reconstruction, experimental results.

Text Books:

[1] Shashi Phoha, Thomas F. La Porta , Chrisher Griffin, "Sensor Network Operations", Wiley-IEEE Press March 2006.
[2] Jr. Edger H. Callaway, "Wireless sensor networks", CRC Press.

References:

[1] I. F. Akyildiz and M. C. Vuran, "Wireless Sensor Networks", John Wiley and Sons Publ. Company
[2] Feng Zho, Morgan Kaufmann ,"Wireless Sensor Networks: An Information Processing Approach".

MULTICAST COMMUNICATION			
Course Code:	**EC515/EC651**	**Credits:**	**3**
No. of Lectures (Hrs/Week):	**3**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

Unit I: Multicast Communication

Types of Communication, Scalability, Applications of Group Communication, Characteristics of Groups - Special Aspects of Group Communication Quality of Service: What is QOS?, Describing a stream, Queuing techniques, Signalling QOS requirements, Integrated Services, RSVP, ST2, Differentiated Services, Differences and Integration Options, Multi Protocol Label Switching, Subnet Bandwidth Manager, Improving QOS in the best effort class - Issues in slow links

Unit II: Multicat Routing

Multicast Routing: Introduction, frame work, Controlling scope, delivery tree, Basic Routing Algorithms, Group Dynamics, Scoping and Multicast Address Allocation, Source-Based Routing, Steiner Trees, Trees with Rendezvous Points, Multicast Routing in the Internet, DVMRP ,MOSPF, PIM ,CBT, Multicast Routing between Domains

Unit III: Multicast in IP

The IP -Host Name Resolution - IP multicast, RTP, RTCP, RSVP, RTSP, Ipv6, IGMP (v1, v2 & v3), IP multicast applications - IP multicast security issues, Switching technology, multicast,Replication, Mirroring and Caching , IP TV.

Unit IV: Multicast in Transport Protocols

UDP , XTP, MTP ,RMP, LBRM, SRM, RMTP, PGM, MFTP Inter-domain multicast routing, Multicast caveats, multicast on non-broadcast media, flooding, address allocation,Multicast in LANs

Unit V: Mbone and Multicast Security

the Multicast Backbone of the Internet, MBone Architecture, MBone Tools, Mbone Applications, Multicast routing and Mobile Systems, Multicast and DiffServ, Active Networks for Supporting Group Communication - Group Management for Large Dynamic Groups - Video conferencing, SDR : session directory, VIC & VAT , Reliable Multicast, Security issue of Source, Security issues of receivers.

Text Books:

[1] Multicast Communication: Protocols, Programming, & Applications, Morgan Kaufmann in Networking, Ralph Wittmann, Martina Zitterbart, Edition 2001, Academic Press, USA.
[2] Multicast Networking And Application, Kennet Miller AW Publication , 1999
[3] IP Telephony, Oliver Hersent, David Gurle, Jean - Pierre Petit, A, Pearson Asia , LPE, 2001
[4] Multicast Sockets: Practical Guide for Programmers by David Makofske, Kevin Almeroth, Edition 2003, Elsevier, USA.
[5] Introduction to Data Multicasting, IP Multicast Streaming for Audio and Video Media Distribution Lawrence Harte, First Edition, 2008, Althos Publishing House.

References:

[1] Multicast Communication: Protocols, Programming, & Applications, Morgan Kaufmann in Networking, Ralph Wittmann, Martina Zitterbart, Edition 2001, Academic Press, USA.
[2] Multicast Networking And Application, Kennet Miller AW Publication , 1999
[3] IP Telephony, Oliver Hersent, David Gurle, Jean - Pierre Petit, A, Pearson Asia , LPE, 2001
[4] Multicast Sockets: Practical Guide for Programmers by David Makofske, Kevin Almeroth, Edition 2003, Elsevier, USA.

COMPUTING LAB			
Course Code:		**Credits:**	**2**
No. of Lectures (Hrs/Week):	**2**		
Total No. of Lectures:	**15**	**End Sem Exam Hours:**	**2**

Programs/Experiments List:

Note: All experiments contents are from the Advanced Network Technologies Virtual Lab (Part of the SAKSHAT VIRTUAL LABS, INDIA)

1. Basics of Network Simulation
   Introduction | Platform required to run network simulator | Backend Environment of Network Simulator | Basics of Tcl Programming for NS-2 | Agents and applications | Tracing
2. Simulating a Local Area Network
   Local Area Network | LAN Topologies | MAC Protocols | Taking turns | Ethernet | Ethernet Frame Structure | Ethernet Versions | Simulating a LAN using Network Simulator 2
3. Measuring Network Performance
   Network Performance Evaluation | Performance Evaluation Metrics | Parameters Affecting the Performance of Networks | Performance Evaluation Techniques | Network Performance Evaluation using NS-2
4. Simulation of a Satellite Network
   Satellite | Simulating a Satellite network in ns2 | Geostationary satellite nodes | Terminal nodes | Polar orbiting satellite nodes(Non-geostationary satellite) | Satellite links | Handoffs | Routing | Structure of trace files in Satellite network
5. Simulating a Wi-Fi Network
   Wi-Fi Networks | IEEE 802.11 Standards | Hardware Requirements for Wi-Fi | How to connect to the Wi-Fi Networks? | Advantages of Wi-Fi | Limitations | MAC Protocols | Use of RTS/CTS to Exchange Data | Issues in Wi-Fi Networks | The Hidden Terminal Problem | Solution of Hidden Terminal Problem | Exposed Terminal Problem | Solution to the Exposed Terminal Problem | Simulating a Wi-Fi using Network Simulator 3
6. Simulating a WiMAX Network
   WiMAX Network | Standards | Comparison of Wi-Fi and WiMAX | How WiMAX works ? | Limitations of WiMAX | Modulation Shemes | Here some terminology,expression and table are given below | Difference between low symbol rate and high symbol rate | WIMAX module for NS-2 | How to download and install patch for WIMAX? | Addressing Format in ns2 | The Default address format | The Hierarchical address format | Wireless (New) Trace File Format | Description of New Trace File Format | Wireless Trace File Format
7. Simulating a Mobile Adhoc Network
   Ad Hoc Network | Mobile Ad-hoc NETwork (MANET) | Routing | Routing in MANET | Routing protocols for MANET | Destination-Sequenced Distance-Vector (DSDV) algorithm: | Dynamic source routing (DSR) | Application of MANET | Advantages | Disadvantages | Simulating a MANET using Network Simulator 2
8. Simulating a Wireless Sensor Network
   Wireless Sensor Networks | Basic Characteristics of WSNs | Operating Systems for WSNs | Differences with Mobile Ad hoc Networks | Types of Wireless Sensor Networks | Routing protocols for WSNs | Clusters and Cluster heads in WSNs | The LEACH Protocol | Operation of LEACH | Discussions on LEACH | Applications of WSNs | Simulating a WSN using Network Simulator 2
9. Setting up a Bluetooth Network
   Bluetooth Network | Who started Bluetooth ? | Bluetooth vs Wi-Fi | Bluetooth – Power Classes | Bluetooth - Versions | How does Bluetooth work ? | Networking of Bluetooth | How to connect Bluetooth ? | Simulating Bluetooth Network with NS-2
10. Setting up a ZigBee Network
    ZigBee Network | IEEE 802.15.4 and ZigBee | ZigBee vs. Bluetooth | Features & Characteristic of ZigBee Technology | Application of ZigBee Technology | Component of IEEE 802.15.4 LR-WPAN | Network Topologies | ZigBee Architecture | The Superframe structure | Nodes Configuration | Energy Model

DISCRETE SIGNAL TRANSFORMATIONS			
Course Code:	**EC639**	**Credits:**	**4**
No. of Lectures (Hrs/Week):	**3+1T**	**Mid Sem Exam Hours:**	**2**
Total No. of Lectures:	**45**	**End Sem Exam Hours:**	**3**

UNIT I: Digital Filter Design

Amplitude and phase responses of FIR filters - Linear phase filters - Windowing techniques for design of Linear phase FIR filters - Rectangular, Hamming, Kaiser windows - frequency sampling techniques - IIR Filters - Magnitude response - Phase response - group delay - Design of Low Pass Butterworth filters (low pass) - Bilinear transformation - prewarping, impulse invariant transformation.

UNIT II: Discrete Random Signal Processing

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.

UNIT III: 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, ARMA model based spectral estimation, Parameter Estimation -Yule-Walker equations, solutions using Durbin's algorithm

Unit IV: 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: Multirate Digital Signal Processing

Mathematical description of change of sampling rate - Interpolation and Decimation, Decimation by an integer factor - Interpolation by an integer factor, Sampling rate conversion by a rational factor, Filter implementation for sampling rate conversion- direct form FIR structures, Polyphase filter structures, time-variant structures, Multistage implementation of multirate system. Application to sub band coding - Wavelet transform and filter bank implementation of wavelet expansion of signals.

Text Books:

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

[2] John G.Proakis, Dimitris G.Manolakis, Digital Signal Processing Pearson Education, 2002.

[3] Rafael C. Gonzalez, Richard E.Woods, Digital Image Processing, Pearson Education, Inc., 2nd Edition, 2004.

References:

[1] John G.Proakis et.al., Algorithms for Statistical Signal Processing, Pearson Education, 2002.

[2] Dimitris G.Manolakis et.al., Statistical and adaptive signal Processing, McGraw Hill, Newyork,2000.

COMPUTING LAB			
Course Code:	**EC681**	**Credits:**	**2**
No. of Lab (Hrs/Week):	**3**	**End Sem Exam Hours:**	**2**
Total No. of Lab Sessions:	**10**		

List of Experiments

1. Study and Analysis of Network Simulator-2
   a. Location of different Protocols.
   b. Simulate a Network.
   c. Modify a C++ code in NS-2
   d. Use a trace file
2. Study and Analysis of QualNet.
   a. Location of different Protocols.
   b. Simulate a Network.
   c. Modify a C++ code.
   d. Create the results for analysis.
3. Simulate a research Paper related to MANET using NS-2/Qualnet.
4. Simulate a research Paper related to Sensor using NS-2/Qualnet.
5. Simulate a research Paper related to Multicast Network using NS-2/Qualnet.
6. Simulate a research Paper related to Security using NS-2/Qualnet.
7. Simulate a research Paper related to Congestion Control in Wireless using NS-2/Qualnet.
8. Simulate a research Paper related to V-Network using NS-2/Qualnet.
9. Simulate a research Paper related to Routing Protocol of wired Network using NS-2/Qualnet.
10. Simulate a research Paper related to Routing Protocol of Wireless Network using NS-2/Qualnet.
11. Performance Evolution of firewall in Networking (If resource available).
12. Performance Evolution of IP cameras in Networking. (If resource available)
13. Performance Evolution of Phone in Networking (If resource available).
14. Performance Evolution of Network Server(If resource available).
15. Mini Project (Network Driver, Network Performance Analysis Tool, etc.)