M.TECH. IN ELECTRONICS AND COMMUNICATION ENGINEERING (WIRELESS COMMUNICATION)

CURRICULUM AND SYLLABUS

(Effect from the Academic Year 2006 – 07)

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605014.

M.TECH. IN ELECTRONICS AND COMMUNICATION ENGINEERING (WIRELESS COMMUNICATION)

COURSE CURRICULUM AND SCHEME OF EXAMINATION

(Minimum Credit Requirement for the completion of the Programme: 72)

ELIGIBILITY:

M.Tech. in Electronics and Communication Engineering (Wireless Communication) : Candidates for admission to the first semester of the four semester M.Tech. Course in Electronics and Communication Engineering should have passed B.E/ B.Tech in Electronics & Communication Engineering / Electronics Engineering / Computer Science & Engineering / Information Technology (or) an examination of any University or Authority accepted by the Pondicherry University as equivalent thereto, with at least 55% marks in the degree examination or equivalent CGPA.

SEMESTER – I

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC911	Wireless Communication Systems	3	1	0	4	40	60	100
2.	EC912	Advanced Digital Signal Processing	3	1	0	4	40	60	100
3.	EC913	Mobile Satellite Communication	3	1	0	4	40	60	100
4.		Elective – I	3	1	0	3	40	60	100
5.		Elective – II	3	1	0	3	40	60	100
6.	EC917	Wireless Laboratory (Design and Simulation)	-	-	3	2	50	50	100
						20	250	350	600

SEMESTER – II

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC914	OFDM for Wireless Communication	3	1	0	4	40	60	100
2.	EC915	Random Process And Queuing Theory	3	1	0	4	40	60	100
3.	EC916	CDMA Technology	3	1	0	4	40	60	100
4.		Elective – III	3	0	0	3	40	60	100
5.		Elective – IV	3	0	0	3	40	60	100
6.		Elective –V	3	0	0	3	40	60	100
7.	EC918	Seminar	-	-	6	2	100	-	100
						23	340	360	700

SEMESTER – III

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.		Elective – VI	3	1	0	3	40	60	100
2.		Elective – VII	3	1	0	3	40	60	100
3.	EC919	Project Phase – I	-	-	16	8	100	---	100
4.	EC971	Directed Study	-	-	3	3	200	100	300
						17	380	220	600

SEMESTER – IV

Sl. No.	Code	Subject	Hours / Week			Credits	Evaluation (marks)		
			L	T	P		Internal	External	Total
1.	EC920	Project phase – II	-	-	24	12	250	150	400
						12	250	150	400

LIST OF ELECTIVE SUBJECTS

SL.NO.	Code	SUBJECT
1	EC941	DATA COMPRESSION
2	EC 942	DIGITAL LOGIC DESIGN WITH VHDL
3	EC 943	EMBEDDED SYSTEMS
4	EC 944	FREE SPACE OPTICAL COMMUNICATION
5	EC 945	HIGH PERFORMANCE COMPUTING NETWORKS
6	EC 946	MOBILE ADHOC NETWORKS
7	EC 947	OPTICAL NETWORKS
8	EC 948	RF MEMS FOR WIRELESS COMMUNICATIONS
9	EC949	SENSOR NETWORKS
10	EC 950	SIMULATION OF WIRELESS COMMUNICATION SYSTEMS
11	EC 951	WIRELESS LAN AND PAN
12	EC 952	WIRELESS SECURITY

EC950 SIMULATION OF WIRELESS COMMUNICATION SYSTEMS

UNIT-I: Introduction to simulation approach

Methods of performance evaluation-simulation approach- Advantages and limitations. System model steps and its types involved in simulation study. Error sources in simulation. Role of simulation in communication system and random process. Introduction to random variables - univariate models (discrete and continuous) and multi-variate models.

UNIT-II: Review of Stochastic process and parameter estimation

Stochastic process: Definitions, properties – stationarity, time averaging and ergodicity, random process models, Monte Carlo simulation, properties, generation and techniques for generating random numbers and processes.

Parameter estimation: Quality of an estimator, estimating average power probability density function, estimation of power spectral density of a process, delay and phase. SNR estimation and importance sampling.

UNIT-III: Modeling of Communication systems

Introduction to modeling of communication systems - Information sources, source coding, base band modulation, channel coding, RF and optical modulation, filtering, multiplexing, detection/demodulation- carrier and timing recovery for BPSK and QPSK. Modeling considerations for PLL.

UNIT-IV: Communication channel models

Statistical characterization of multipath channels and time-varying channels with Doppler effects, models for multipath fading channels. Finite state channel models – channels with and without memory. Methodology for simulating communication systems operating over fading channels.

UNIT-V: Simulation of queues and computer networks

Queuing models: Characteristics of queuing systems, performance parameters, simulation of queuing systems (M/M/1, M/G/1), steady state behaviour of infinite population. Markovian models and finite population models. Jackson networks, networks of queues, flow control.

Simulation of computer networks: Traffic modeling, MAC protocols, data link layer, TCP, model construction.

TEXT BOOKS:

1. M.C. Jeruchim, Philip Balaban & K.Sam shanmugam. "Simulation of communication systems", Plemum press, New York, 1992
2. M.Law & W.David Kelton ," Simulation Modelling and analysis" ,McGraw Hill, New York, 1999.
3. K.Hayes, "Modelling and Analysis of computer communication networks", Plenum press, New York, 1984.
4. Banks, J.S.Carson, Nelson and D.M.Nicol, "Discrete –Event system simulation", Prentice Hall of India, 4th Edition, 2005 .

5. Z.Peebles , "Probability, Random Variable and Random Signal Principles", Tata McGraw Hill, 4th edition 2002.

EC 915 PROBABILITY AND QUEUEING THEORY

Unit – I: Discrete Random Variables

Random Variables and their event spaces – The probability mass function- Distribution functions – Special discrete distributions (Bernoulli, Binomial and Geometric, Negative Binomial, Poisson, Hypergeometric, Discrete Uniform, Constant, Indicator) – Probability Generating function.

Unit – II: Continuous Random Variables

The Exponential distribution – The Reliability, Failure density and Hazard function – Some important distributions (Hypoexponential, Erlang, Gamma, Hyperexponential, Weibull, Gaussian, Uniform and Pareto distributions)

Unit – III: Stochastic Processes

Definition, Classification of Stochastic Processes - Strictly Stationary Process, Wide Sense Stationary, Independent Process, Renewal Processes – Availability analysis, Bernoullli process – Poisson process – Renewal processes – Availability analysis.

Unit – IV: Discrete Parameter Markov Chains

Introduction, Computation of n-step transition probabilities – Chapman-Kolmogorov equation – State classification and limiting Probabilities – M/G/I queueing system, Pollaczek-Khinchine transform equation.

Unit – V: Continuous Parameter Markov Chains

The Birth and Death process (M/M/1, M/M/C, M/M/1/N, M/M/C/N (N>C), M/M/C/C, M/M/∞ models only, derivation of Mean number of customer in the system, in the queue and Waiting time – Simple applications) – Special case of Birth and Death model (Pure Birth and Pure Death Processes)

Text Book:

1. Kishor S.Trivedi, Probability and Statistics with Reliablity, Queueing and Computer Science Applications, second Edition, 2002, John Wiley & Sons, Inc.

Reference:

1. J.Medhi, Stochastic Processes, New Age International (P) Ltd., Second Edition, 1994.
2. D.Gross and C.M.Harris, Fundamentals of Queueing Theory, Third Edition, Wiley Students Edition.

EC949 SENSOR NETWORKS

UNIT I

Introduction –Sensor Networks-challenges for WSNs - Difference between sensor networks and Traditional sensor networks –Types of Applications –Enabling Technologies for Wireless Sensor Networks –Single Node Architectures –Hardware Components – Energy Consumption of Sensor Nodes

UNIT II

Network Architecture – Sensor Network Scenarios –Optimization Goals and Figures of Merit – Design Principles for WSNs- Gateway Concepts – Need for gateway – WSN to Internet Communication – Internet to WSN Communication –WSN Tunneling

UNIT III

Communication Protocols – Physical layer and transceiver Design considerations in WSNs – MAC Protocols – Fundamentals of MAC protocols – Low duty cycle and wake up concepts – Contention based protocols – Schedule based protocols – The IEEE 802.15.4 MAC Protocols

UNIT IV

Link layer protocols – Fundamentals: Tasks and Requirements – Error control – Framing – Link Management – Routing Protocols – Gossiping and agent based unicast forwarding – Energy efficient unicast – broadcast and multicast – Geographic Routing Mobile nodes

UNIT V

Data Centric and content based networking – Addressing data – Data centric routing – Data Aggregation – Transport layer and quality of service – Advanced application Support - Security - Target and edge detection-

REFERENCES

1. Holger Karl, Andreas Wiilig, “Protocols and Architectures For Wireless Sensor Networks” John Wiley & Sons Limited 2005.

2. I.F .Akyildiz,Weillian, “A Survey on Sensor Networks”,IEEE Communication Magazine, August 2002

3. Jon Wilson , “Sensor Technology hand book” Elsevier publications 2005

4. Anna Hac “Wireless Sensor Networks Design” John Wiley& Sons Limited Publications 2003

EC911 WIRELESS COMMUNICATION SYSTEMS

UNIT I

Cellular Concept –systems Design Fundamentals : Frequency Reuse - Channel Assignment & Handoff Strategies – Interference and System Capacity – Trunking and Grade of Service – Improving Coverage & Capacity in Cellular Systems – Radio Wave Propagation – Free Space Propagation Model – Basic Propagation Mechanisms – reflection – Ground Reflection Model – Diffraction – Scattering – Practical link budget design – Outdoor and Indoor Propagation Models – Signal penetration into buildings – Ray Tracing and site specific Modeling.

UNIT II

Mobile Radio Propagation - Small-Scale fading and multipath : Small scale multipath Propagation – Impulse response model of a multipath channel – parameters of mobile multipath channels – Types of small scale fading – Statistical for multipath channels – Multipath shape factors for small scale fading wireless channels.

UNIT III

Error Control Coding : Linear Block Codes – Cyclic Codes – Optimum soft Decision decoding – Hard Decision decoding – Bounds on minimum distance – Non-binary, concatenated Block Codes – Interleaving of coded data for channels with burst errors – Serial and Parallel concatenated block codes – Convolutional codes: Transfer Function – Viterbit Algorithm – Soft decision & hard decision decoding – Distance Properties – Punctured Convolutional codes – Non-binary Dual-K codes and Concatenated codes – Trellis coded Modulation.

UNIT IV

Modulation technique for mobile radio : Amplitude modulation – Angle modulation – Digital modulation – Line Coding – Pulse Shaping techniques – Geometric representation of modulation signals – Linear modulation techniques – Constant envelope modulation – combined linear and constant modulation techniques – Spread spectrum modulation – Modulation Performance in fading and multipath channels.

UNIT V

Equalization, Diversity, Multiple Access Techniques : Fundamentals of Equalization – Training a generic adaptive equalizer – Equalizers in communication receiver – Linear Equalizer Non-linear Equalization – Algorithm for adaptive equalization – Fractional Equalizer – Diversity Techniques – RAKE receiver – Interleaving, Frequency Division Multiple Access (FDMA) Spread Spectrum Multiple Access – Space Division Multiple Access(SDMA) – Packet Radio.

Text Books:

1. Theodore S. Rappaport, "Wireless Communications", Pearson Education, 2002.
2. John G. Proakis, "Digital Communications", Fourth Ed. McGraw Hill International Edition, 2000.

References:

1. Simon Haykin "Communication Systems" , 3rd Edition, John Wiley, 2002.
2. Edward Lee and David Messerschmitt, "Digital Communication", Kluwer Academic Publications, 1993.

EC945 HIGH PERFORMANCE COMPUTING NETWORKS

UNIT I

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

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

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

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

UNIT V

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

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
4. Behrouz.a. Forouzan, "Data Communication and Networking", Tata Mc Graw Hill, New Delhi,2000.

EC 917 DESIGN AND SIMULATION OF WIRELESS LABORATORY

1. Generation of Voice, Data and Video traffic.
2. Simulation of the Radio Channel.
3. Simulation of Hand off mechanisms.
4. Simulation of CDMA Transmitter and Receiver.
5. Coding Techniques for Wireless Communication.
6. Link Budget.33
7. Simulation of Security Algorithms.
8. Study of Glomosim and NS2.

EC914 OFDM FOR WIRELESS COMMUNICATION

UNIT – I

OFDM Basics: Introduction to Wireless OFDM – OFDM principles, system model – Generation of sub carrier using IFFT, Guard time and cyclic extension, windowing, choice of OFDM parameters, OFDM signal processing.

UNIT – II

Coding and Modulation: Introduction – Forward error correcting coding – Interleaving – Quadrature Amplitude modulation – Coded modulation – Synchronization – sensitivity to phase noise and frequency offset and timing errors – Synchronization using cyclic extension and special training symbols.

UNIT – III

Channel estimation for OFDM system: Coherent and Differential Detection – Coherent detection – one and two dimensional channel estimators, special training symbols, Decision directed channel estimation – Differential detection – Differential detection in the time and frequency domain – Differential amplitude and phase shift keying.

UNIT – IV

Orthogonal Frequency Division Multiple Access: Frequency hopping in OFDMA, Difference between OFDMA and MC-CDMA. OFDMA system description – channel coding, modulation, Time and Frequency synchronization, Initial modulation timing and frequency offset synchronization accuracy, power control, Random frequency hopping operation – Dynamic channel allocation (simple and fast) – capacity of OFDMA.

UNIT – V

Application of OFDMA: Digital Audio Broadcasting – Front end Impairments in the OFDM modem – system simulation tools – Analysis and simulation of the main front end effects – Terrestrial digital video broadcasting – Magic wand (Wireless ATM project).
IEEE 802.11, Hyper LAN/ 2 and MMAC, Wireless LAN standards – OFDM parameters, channelization, OFDM signal processing, Training, Difference between IEEE 802.11, Hyper LAN/ 2 and MMAC.

References:

1. Richard Van Nee and Ranjee Prasad, "OFDM for Wireless Multimedia Communication", Artech House, 2000.
2. Mare Engels, "Wireless OFDM systems", Klumer Academic publishers, 2002.
3. Prasad. R, "Universal Wireless Personnel Communications", Artech House, 1998.

EC913 MOBILE SATELLITE COMMUNICATION

UNIT I

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

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

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

UNIT IV

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

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.

Text books:

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. Tri.T.Ha, "Digital Satellite Communication Systems Engineering", McGraw Hill, 1998

EC916 CDMA TECHNOLOGY

UNIT I

CDMA as a protocol – Multiple Access Techniques – classification of multiple access protocols – contention less (scheduling) multiple access protocols – contention (random) multiple access protocols – Code division multiple access (CDMA) protocols - CDMA system concepts – spread spectrum multiple access – Code generation – DSCDMA with imperfect power control – Near – far effect – multi user interference in the reverse link and forward link.

UNIT II

Indoor CDMA systems – Propagation characteristics – system model – bit error probability (BEP) analysis – Packet switching – Outdoor CDMA Systems – Propagation characteristics – system model – BEP analysis – Throughput and delay analysis – Mobile Satellite CDMA Systems – System model – Performance Analysis – Throughput and delay Analysis.

UNIT III

Hybrid Direct – Sequence / slow Frequency Hopping CDMA systems – transmitter model – channel model – receiver model – bit error probability (BEP) – BEP for BPSK and QPSK modulation – throughput and delay analysis – slotted CDMA protocol using the Markov chain model – Performance Analysis - Performance Analysis using forward error correcting (FEC) code.

UNIT IV

Hybrid CDMA/ ISMA protocol - Protocol description – Markov model – System model – Bit error probability – protocol simulation – analytical and simulation results.

UNIT V

CDMA for personal communication – introduction – synchronization – interference cancellation – coexistence of CDMA – Joint detection CDMA – future CDMA schemes.

Text Book :

1. Ramjee Prasad,"CDMA for Wireless Personal Communication", Artech House Mobile Communication Series, 1996.

References :

1. Vijay Kumar Garg, "Applications of CDMA in Wireless / Personal Communications", (Feher / Prentice Hall Digital And Wireless Communication Series), 1996.
2. Andrew J. Viterbi, "CDMA : Principles of Spread Spectrum Communication", (Addison – Wesley Wireless Communications), 1995.
3. Man Young Rhee, Rhee Man Young, "CDMA Cellular Mobile Communications and Network Security", 1997.
4. Samuel C Yang, "CDMA RF System Engineering", - (Artech House Mobile Communication Library) , 1998.

CDMA Technology

Unit I

The CDMA concept: Need for spread spectrum communication-Spreading codes-Direct sequence and Frequency hopping spread spectrum communication system-Spread spectrum performance-Basic DS CDMA Elements-RAKE receiver-power control-soft handover-Inter frequency handover-Multiuser detection-Capacity-Effects of loading, sectorization and voice activity.

Unit II

Link structure and Call processing: Asymmetric links-Forward link-Pilot channel-Sync channel-Paging channel-Traffic channel-Modulator-Reverse link-Access channel-Traffic channel-Call processing states-Initialization state-Idle state-Access state-traffic channel state.

Unit III

CDMA Design Engineering: Forward Link analysis-Pilot channel-Traffic channel-Reverse Link-Traffic Channel_Reverse link rise-Frequency reuse factor-PN offset planning- short PN sequences-Co-PN offset-Adjacent PN offset.

Unit IV

CDMA performance and Traffic engineering: Channel supervision-power control parameters-Search window sizes-Field optimization.-Traffic intensity-Loads-Grade of service-Erlang-B Model-Erlang-C model-CDMA applications-soft and hard blocking.

Unit V

Next Generation CDMA: Physical channel-Multirate design-Spreading technique-Advanced error control techniques-Coherent detection-Inter operability in next generation CDMA-Multi carrier CDMA option-Forward link-Reverse link.

Reference books:

1. .*Samuel C.Yang*, CDMA RF System Engineering,Artech house,1998.
2. *John B.Groe and Lawrence E.Larson*,CDMA Mobile Radio Design, Artech house,2000.
3. *Kamil SH.Zingangirov*, Theory of Code Division Multiple Access Communication, IEEE press-Wiley Interscience,2004.

EC912 ADVANCED DIGITAL SIGNAL PROCESSING

EC951 WIRELESS SECURITY

UNIT I

Introduction: Attacks – Services – Mechanisms – Conventional Encryption – Classical and Modern Techniques – Encryption Algorithms – Confidentiality.

UNIT II

Public Key Encryption: RSA – Elliptic Curve cryptography – Number Theory Concepts.

UNIT III

Message Authentication: Hash Functions – Digest Functions – Digital Signatures – Authentication Protocols.

UNIT IV

Network Security Practice: Authentication, Applications – Electronic Mail Security-IP Security –Web Security.

UNIT V

System Security: Fire Walls – Current standards.

Text Book:

1. Stallings,"cryptography and Network Security – Principles & Practice", Prentice Hall, 1998.

References:

1. Bruce, Schneier, "Applied Cryptography" , 2nd Edition, Toha Wiley & Sons,1996
2. Douglas R.Stinson , "Cryptography – Theory and practice" , CRC Press,1995.

EC944 FREE SPACE OPTICAL COMMUNICATION

UNIT I

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

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

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

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

UNIT V

Optical Signal Processing: Analog and Discrete systems – Noise and Stochastic processes – Filters – Power spectra estimation – Ambiguity function, Wigner distribution function and triple correlations.

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.

EC943 EMBEDDED SYSTEMS

UNIT I

Embedded Hardware Architecture – 32 Bit Microcontrollers : ARM 2 TDMI core based 32 Bit microcontrollers and family of processors, Register, Memory and Data transfer, Arithmetic and Logic instructions, Assembly Language, I/O operations interrupt structure, ARM cache. ARM Bus, Embedded systems with ARM. **Networks for Embedded systems:** Serial bus protocols: The CAN bus, and the USB bus, Parallel bus protocols: The PCI Bus and GPIB bus, **The Embedded Computing Platform:** Design, PC as a platform, Development. Environment, Debugging techniques and Debugging Challenges.

UNIT II

Program Design and Analysis: Formalism for system design using UML (Unified Modeling Language) Model for Program flow graph (flow graphs). Basic Compilation techniques, Analysis and optimization of execution time, program size, energy and power. **Processes and Operating system**: Multiple tasks and processes, context switching, OS states, structure, timing requirements, Scheduling policies, and Inter- process communication Mechanisms Evaluating OS performance, Power Optimization strategies for processes.

UNIT III

Real Time Scheduling: Systems of State Machines: State-machines, State charts, **Declarative specifications:** Regular expressions and extn, traditional logics and real-time logic. **Deterministic scheduling:** assumptions and candidate Algorithms, RM (rate monotonic) and EDF (earliest deadline first), realizing the assumptions, priority inversion and inheritance, **Execution time prediction:** Approaches and issues, measurement of S/W by S/W, program analysis by timing scheme, prediction by optimization and system interferences and architectural complexities. **Keeping time on computers:** Timer applications, properties of real and ideal clocks, clock servers and clock synchronization, real time language features.

UNIT IV

Real time operating systems: Real time function and services, real time UNIX and POSIC processes and threats. Comparative study of sample of RTOS such as eCOS, real time Linux, Windows CE.

UNIT V

Validation and testing of Embedded Systems: Program validation and testing, clearbox testing, blackbox, evaluating function tests and performance testing. System design techniques: Design methodologies, requirements analysis, specifications , quality assurance.

Text Books:

1. (Unit I, II &V) Wayne Wolf, Computers as Components – Principles of Embedded Computing system Design – Harcourt India Pvt. Ltd – Morgan Kaufmann Publishers – First Indian Reprint 2001, Chapter 1, 5, 6, 7, 8, 9 & Appendix A on UML.
2. Philip A. Laplante, Real time systems analysis and design – an Engineer's. Handbook IEEE Computer Society Press PHI, Second edition. 1997 Chap 6, 7, 9,10.
3. (Unit III &IV) Allan C. Shaw – Real time systems & Software – John Wiley & Sons – India Reprint 2001 Chapter 4 – 10.

References:

1. Karl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5th Edition McGraw Hill, 2002, Chap 3,4,9,10 (Course material for ARM processors only).
2. Frank Vahid & Tony Givargis, "Embedded system design – A unified hardware / software introduction ", John Wiley & Sons, India 2002 – Chap 6-8 only.
3. Stephen B. Furber, "ARM system architecture", Addison Wesly, 1996.
4. Rajkamal,"Embedded systems–architecture, programming and design", TMH India 2003.

EC946 MOBILE ADHOC NETWORKS

UNIT I

Introduction – Model of operation – Layer 2 Ad hoc solutions – Proactive - Reactive protocols – Multi cast – Applications – Routing Protocols.

UNIT II

DoD on Mobile Ad hoc – Packet Radio – MANET – GLOMO – DSDV – Routing Methods – Link state Distance Vector – DSDV protocol – Route table- Route selection – Examples of DSDV – properties of DSDV.

UNIT III

Clustering – Link cluster Architecture – Clustering for Back bone formation – Routing efficiency – DSR protocols – Properties – Multicast.

UNIT IV

AODV protocols – properties – unicast – Multicast Broadcast – Optimization - ZRP protocol – ZRP description – Link reversal routing.

UNIT V

Battery life – power issues – Associativity routing – ABR protocol – routing – Mobility – Beconing on Battery life – STAR – Scalability – QoS – Security – power control.

Reference:

Charles E. Perkins, "Ad hoc Networks", Addison – Wesley, 2000.

EC951 WIRELESS LAN AND PAN

UNIT I

Basic of Networks: Telephone, Computer, cable television and wireless networks, networking principles, digitization: service integration, network services and layered architecture, traffic characterization and QoS, network services: network elements and network mechanisms.

UNIT II

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

Internet and TCP/IP Networks: Overview – Internet protocols – TCP and VDP, performance of TCP/IP networks circuits – switched networks: SONET, DWDM, Fiber to the home, DSL, Intelligent networks, CATV.

UNIT IV

ATM and Wireless Networks: Main features – addressing signaling and routing; ATM header structure – adaptation layer, management and control; BISDN; interworking with ATM, wireless channel, link level design, channel access; Network design and wireless networks.

UNIT V

Optical Networks and switching: optical links – WDM systems, cross-connects, optical LANs, optical paths and networks; TDS and SDS: modular switch designs – packet switching, distributed, shared, input and output buffers.

Text Book:

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kauffman, London, 2000.

References:

1. Leon Garcia, Widjaja, "Communication Networks", Tata McGraw Hill, New Delhi, 2000.
2. Sumit Kasera, Pankaj Sethi, "ATM Networks", Tata McGraw Hill, New Delhi, 2000.
3. Behrouz A. Forouzan, "Data Communication and Networking", Tata McGraw Hill, New Delhi, 2000.

EC 947 OPTICAL NETWORKS

UNIT – I

WDM Technology and Issue in WDM optical networks: Introduction – Optical networks – WDM – WDM optical networking evolution – Enabling Technologies for WDM optical networks – WDM optical network architecture – Issues in Wavelength routed networks – Next generation optical Internet networks.

UNIT – II

Wavelength Routing algorithms: Introduction – Classification of RWA algorithms – RWA algorithms – Fairness and Admission control – Distributed control protocols – Permutation routing and Wavelength requirements.

Wavelength Rerouting algorithms: Introduction – Benefits of Wavelength routing – Issues in Wavelength routing – Ligthpath Migration – Rerouting schemes – Algorithm AG – Algorithm MWPG – Rerouting in WDM networks with Sparse Wavelength conversion – Rerouting in Multifiber Networks – Rerouting in Multifiber Unidirectional Ring networks.

UNIT – III

Wavelength Convertible networks: Introduction – Need for Wavelength converters – Wavelength convertible switch architecture – Routing in convertible networks – Performance evaluation of convertible networks – Networks with Sparse Wavelength conversion – Converter placement problem – Converter allocation problem.

UNIT – IV

Virtual Topology Design: Introduction – Virtual topology design problem – Virtual topology design sub problems – Virtual Topology Design Heuristics – Regular virtual topology design – predetermined virtual topology and lightpath routes – Design of multi fiber networks.

Virtual Topology Reconfiguration: Introduction – Need for virtual topology reconfiguration – Reconfiguration due to Traffic changes – Reconfiguration for Fault restoration.

UNIT – V

Network Survivability and Provisioning: Failures and Recovery – Restoration schemes – Multiplexing techniques – Distributed control protocols. Optical Multicast routing – Next Generation optical Internet networks.

References:

1. C. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts, Design and Algorithms", Prentice Hall India, 2002.
2. Rajiv Ramasami and Kumar N. Sivarajan, "Optical Networks: A Practical Perspective", A Harcourt publishers international company, 2000.

EC942 DIGITAL LOGIC DESIGN WITH VHDL

UNIT I

Design Concepts: Digital Hardware: Standard chips programmable logic devices- custom – design chip – design process – design of digital hardware - basic design loop – design of digital hardware – introduction to CAD tools – design entry synthesis - functional simulation – introduction to VHDL – Representation of digital signals in VHDL – writing sample VHDL codes – how not to write VHDL codes.

UNIT II

Implementation technology: Transistor switches – NMOS logic gates – CMOS logic gates – Negative logic system – standard chips – programmable logic devices – custom chips, standard cells and gate arrays – practical aspect- MOSFET fabrication and behavior – MOSFET on resistance – transmission gates – implementation details for SPLDS, CPLDS and FPGAs – implementation in FPGAs – optimize implementation of logic functions: Karnaugh Map – Multilevel synthesis – Analysis of Multilevel Circuits – Cubical Representation – Minimization using Cubical representation – Practical consideration – CAD tools.

UNIT III

Combinational circuits building blocks: Multiplexers – decoders – encoders – code converters – arithmetic comparison circuits – VHDL for combinational circuits – Flip-flops, Registers and Counters: basic latch- gated SR latch, gated SR latch with NAND gate – gated D latch – Master slave and edge – triggered D flip-flops – T flip-flop, JK flip-flop – summary of terminology – resistors – counters – using storage elements with CAD tools – using registers and counters with CAD tools – design examples.

UNIT IV

Sequential circuits: Synchronous sequential circuits: Basic design step – state assignment problems – Mealy state model – design of FSM using CAD tools VHDL code for Moore type FSMs – synthesis of VHDL codes – simulating and testing the circuits - serial adder example – state minimization – counter design – FSM as an arbiter circuit – ASM charts – Asynchronous sequential circuits: Asynchronous behavior – analysis and synthesis of asynchronous circuits – state reduction – state assignment – hazards – design examples – Vending machine.

UNIT V

Digital system design: Building block circuits: Flip-flops and registers with enable inputs, shift registers with enable inputs, SRAM, SRAM blocks in PLDs – design examples: Bit-counting circuit, ASM chart implied timing information, shift and add multiplier, divider, arithmetic mean, sort operation - clock synchronization: clock skew, flip-flop timing parameter, asynchronous input – switch debouncing testing of logic circuits: fault model – design for testability – build-in self test – random test – testing PCBs.

Text books:

Stephen Brown and Zvonko Vranesic, "Fundamental of digital logic with VHDL design", Tata McGraw Hill Edi., 2001

References:

1. Navabi, "VHDL Modeling", McGraw Hill, 1997
2. J. Bhaskar, "VHDL Primer", Pearson Education, 1999

EC948 RF MEMS FOR WIRELESS COMMUNICATIONS

UNIT I

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

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

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

Novel RF MEMS – Enabled circuits – reconfigurable circuits – the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS microswitch 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

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.

Text Book:

Hector J. De Los Santos, "RF MEMS Circuit Design for Wireless Communications", Artech House, 2002.

Reference:

1. Vijay K. Varadan, K.J. Vinoy, K.A. Jose, "RF MEMS and their Applications", John Wiley and sons, Ltd., 2002.
2. Gabriel M. Rebeiz, "RF MEMS Theory, Design & Technology", Wiley Interscience, 2002.

EC 941 DATA COMPRESSION

UNIT I

Introduction: Compression techniques – modeling and coding – Huffman coding – Good codes – Huffman coding Algorithm – non binary Huffman codes – Adaptive Huffman coding – application of Huffman coding- lossless image compression – text – audio compression.

UNIT II

Arithmetic coding: Introduction – Coding a sequence – generating, deciphering, the tag – generating a binary code – uniqueness of arithmetic code – algorithm, integer implementation, comparison of Huffman and arithmetic coding – bilevel image (JBIG standard) Compression – image compression.

UNIT III

Dictionary techniques: Static dictionary – adaptive dictionary – LZ 77, LZ 78 approach – applications – file compression – graphics interchange format compression over modems(version. 42 bis) – lossless image compression – facsimile encoding – runlength coding – comparison of MH,MR,MMR & JBIG – progressive image transmission – Linear prediction, context, multiresolution models – modeling prediction errors.

UNIT IV

Differential and subband coding : Basic algorithm – prediction in DPCM – adaptive DPCM – delta modulation – speech coding (G.726) – frequency domain and filtering – basic sub band coding algorithm – applications to speech coding, audio coding – application to image compression – wavelets.

UNIT V

Transform coding: The transform – KL transform – discrete cosine, sine, Walsh Hadamard transform – quantization, coding of transform coefficients – JPEG image compression – application to audio compression – analysis / synthesis schemes – speech compression – channel vocoder – linear predictive coder – code excited linear prediction - sinusoidal coders – fractal compression.

Text Books:

1. Khalid Sayood, "Introduction to data Compression", Morgan Kaufmann Publishers, Inc., California, 1996.

References:

1. Mark Nelson, Jean Louf Goilly, " The Data Compression Book" , BPB Publications, 1996.
2. Rafel C. Gonzalez " Digital Image Processing" , Addison Wesley, 1998.

EC952 WIRELESS SECURITY

UNIT I: Introduction and Symmetric Key Encryption

Attacks-Services-Mechanisms-OSI Security architecture-Model for network security-Symmetric Cipher Model-Substitution and Transposition techniques-Simplified DES-DES Block Cipher Principles-The Strength of DES-Differential and linear cryptanalysis-Block Cipher Design Principles-Block Cipher modes of operation-AES Cipher-Triple DES.

UNIT II: Finite Fields and Public Key Encryption

Groups, Rings and Fields-Modular arithmetic-Euclid's Algorithm-Finite Fields of the form GF(p)-Polynomial arithmetic-Finite fields of the form GF(2n)-Principles of public key Cryptosystems-The RSA algorithm-Key Management-Diffie-Hellman Key Exchange-Elliptic Curve arithmetic-Elliptic curve cryptography.

UNIT III: Message Authentication and Hash Functions

Authentication requirements-Arithmetic functions-Message authentication codes-Hash functions-MD5 message digest algorithm-Digital signatures-Authentication protocols-Digital signature standard.

UNIT IV: Network Security Practice

Authentication application-Kerberos-Electronic mail security-Pretty good primary-S/MIME-IP security overview-IP security architecture-Authentication header Encapsulating security payload-Web security considerations-Secure socket layer and transport layer security-Secure electronic transaction.

UNIT V: System Security

Intruders-Intrusion detection-Password management-Viruses and related threats-Viruses counter measures-Firewall design principles-Types of firewalls-Firewalls configurations-Trusted systems-Blue print for security-Security policy-Systems specific policy-NIST security models-VISA international security model-Hybrid framework.

Text Book:

1. Stallings, "Cryptography and Network Security-Principles and practice", Prentice Hall, 1998.

Reference Books:

1. Principles of Information Security – Michael E. Whitman & Herbert J. Mattord.
2. Bruce, Schneier, "Applied Cryptography", 2nd Edition Toha Wiley and Sons, 1996.
3. Doughas R. Stinson, "Cryptography-Theory and Practice", CRC Press, 1995.