SCHEME OF TEACHING AND EXAMINATION

M.TECH. - DIGITAL COMMUNICATION & NETWORKING

II SEMESTER

Course Code	Subject Code	Name of the Subject	Teaching hours/week			Duration of Exam in Hours	Marks for		Total Marks
			Lecture	Practical	Tutorial		I.A.	Exam	
10LDN21	10EC086	Wireless Communication	4	-	2	3	50	100	150
10LDN22	10EC046	Linear Algebra	3	2	-	3	20+30	100	150
10LDN23	10EC123	Modern DSP	4	-	2	3	20+30	100	150
10LDN24	10EC125	Protocol Engineering	3	2	-	3	50	100	150
10LDN25	10ECxxx	Elective-II	4	-	2	3	50	100	150
		*Project Phase-I (6 week Duration)							
10LDN26		Seminar / Mini-project	--	3	-	--	50	--	50
Total			**18**	**7**	**6**	**15**	**300**	**500**	**800**

ELECTIVE – II

10LDN251	10EC023	Cryptography & Network Security	10LDN253	10EC126	Real Time Operating Systems
10LDN252	10EC131	Wireless and Mobile Networks			

Between the II Semester and III Semester. After availing a vocation of 2 weeks.

II – SEMESTER

WIRELESS COMMUNICATIONS

Subject Code	: **10EC086**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hrs	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Radio Propagation: Free space propagation model, Relating power to electric field, reflection, ground reflection diffraction, scattering, practical link budget design using path loss models, outdoor propagation models, indoor propagation models, signal penetration into buildings, ray tracking and site specific modeling, small scale multi-path propagation, impulse response model of a multi-path channel, small scale multi-path measurements, parameters of mobile multi-path channels, types of small scale fading, Rayleigh and Ricean distributions, statistical models for multi-path fading channels.

Diversity Techniques: Concepts of Diversity branch and signal paths, Combining and switching methods, C/N, C/I performance improvements, Average P_e, performance improvement, RAKE receiver.

Cellular Concept: Frequency reuse, channel assignment strategies, handoff strategies; interference and system capacity, trunking and grade of service, improving coverage and capacity in cellular systems. FDMA, TDMA, spread spectrum multiple access, SDMA, packet Radio, capacity of cellular systems.

Personal Mobile Satellite Communications: Integration of GEO, LEO, and MEO Satellite and Terrestrial mobile systems, personal satellite Communications programs.

CDMA Systems Implementation: Is-95 System Architecture, Soft Handoff and Power Control in IS-95 CDMA, cdma2000 System.

Signal reception: Wireless signaling environment, basic receiver signal processing for wireless, blind multi-user detection, linear receivers for synchronous CDMA, blind multi-user detection direct methods, blind multi-user detection subspace methods, performance of blind multi-user detector, subspace tracking algorithms, blind multi-user detector in multi-path channels.

REFERENCE BOOKS:

Theodore S. Rappaport, "**Wireless Communications: Principles and Practice"**, 2nd edition, Prentice Hall of India, 2005.
Kamilo Feher, "**Wireless Digital Communications: Modulation and Spread Spectrum Techniques**", Prentice Hall of India, 2004.
Vijay K. Garg, "**IS-95 CDMA and CDMA 2000"**, Pearson Education (Asia) Pte. Ltd, 2004.
Xiaodong Wang and Vincent Poor, "**Wireless Communication Systems: Advanced Techniques for Signal Reception"**, Pearson Education (Asia) Pte. Ltd, 2004.

LINEAR ALGEBRA

Subject Code	: **10EC046**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hrs	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Linear Equations: Fields; system of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-factorization.

Vector Spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces.

Linear Transformations: Linear transformations; algebra of linear transformations; isomorphism; representation of transformations by matrices; linear functionals; transpose of a linear transformation.

Canonical Forms: Characteristic values; annihilating polynomials; invariant subspaces; direct-sum decompositions; invariant direct sums; primary decomposition theorem; cyclic bases; Jordan canonical form. Iterative estimates of characteristic values.

Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-factorization; least-squares problems; unitary operators.

Symmetric Matrices and Quadratic Forms: Digitalization; quadratic forms; constrained optimization; singular value decomposition.

REFERENCE BOOKS:

1. C. Lay, "**Linear Algebra and its Applications**," 3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.
2. Kenneth Hoffman and Ray Kunze, "**Linear Algebra**," 2nd edition, Pearson Education (Asia) Pte. Ltd/ Prentice Hall of India, 2004.

Bernard Kolman and David R. Hill, "**Introductory Linear Algebra with Applications",** Pearson Education (Asia) Pte. Ltd, 7th edition, 2003.

Gilbert Strang**,** "**Linear Algebra and its Applications"**, 3rd edition, Thomson Learning Asia, 2003.

MODERN DSP

Subject Code	: **10EC123**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Marks	: 03
Total No. of Lecture Hours	: 52	Exam Hours	: 100

Goal of the course – Advances in Digital Signal Processing involve variable sampling rates and thus the multirate signal processing and hence their applications in communication systems and signal processing. It is intended to introduce a basic course in multirate signal processing especially meant for students of branches eligible for M Tech courses in EC related disciplines.

Review of Signals and Systems – Discrete time processing of continuous signals - Structure of a digital filter; Frequency domain analysis of a digital filter; Quantization error; Sigma and Sigma Delta Modulation. Fourier Analysis – DFT, DTFT, DFT as an estimate of the DTFT for Spectral estimation. DFT for convolution, DFT/DCT for compression, FFT. Ideal Vs non ideal filters, FIR and IIR Filters Digital Filter Implementation; Elementary Operations.

Digital Filters –, State Space realization, Robust implementation of Digital Filters, Robust implementation of equi – ripple FIR digital filters

Multirate Systems and Signal Processing. Fundamentals – Problems and definitions; Upsampling and downsampling; Sampling rate conversion by a rational factor;

Multistage implementation of digital filters; Efficient implementation of multirate systems.

DFT filter banks and Transmultiplexers – DFT filter banks, Maximally Decimated DFT filter banks and Transmultiplexers. Application of transmultiplexers in communications Modulation.

Maximally Decimated Filter banks – Vector spaces, Two Channel Perfect Reconstruction conditions; Design of PR filters Lattice Implementations of Orthonormal Filter Banks, Applications of Maximally Decimated filter banks to an audio signal.

Introduction to Time Frequency Expansion; The STFT; The Gabor Transform, The Wavelet Transform; The Wavelet transform; Recursive Multiresolution Decomposition.

References:

1. Roberto Cristi, "**Modern Digital Signal Processing**", Cengage Publishers, India, (erstwhile Thompson Publications), 2003.
2. S.K. Mitra, "**Digital Signal Processing: A Computer Based Approach"**, III Ed, Tata McGraw Hill, India, 2007.
3. E.C. Ifeachor and B W Jarvis, "**Digital Signal Processing, a practitioners approach**," II Edition, Pearson Education, India, 2002 Reprint.
4. Proakis and Manolakis, "**Digital Signal Processing**", Prentice Hall 1996 (third edition).

PROTOCOL ENGINEERING

Subject Code	: **10EC125**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hrs	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Communication Model, software, subsystems, protocol development methods, protocol engineering process ;

Network Reference Model: services and interfaces, protocol functions, OSI and TCP/IP model,

Protocols: Host to network interface protocols, network protocols transport protocols, application protocols;

Protocol Specifications: Components of protocol, service specifications, entity specifications, interface and interactions, multimedia protocol specifications, HDLC, ABP and RSVP specifications;

SDL: features, communication system using SDL, examples of SDL based protocol specifications, other specification languages;
Protocol Verification, FSM based verification, validation, design errors, validation approaches, verification and validation of ABP using **SDL;** Conformance testing, framework, conformance test architectures, test sequence generation methods, TTCN, multimedia testing,

MPLS Testing; Performance testing methods, testing of TCP and OSPF, interoperability testing, scalability testing;

Protocol Synthesis Algorithms, resynthesis, protocol implementation requirements, methods of implementation, protocol compilers, tools for protocol engineering Assignments / practical can be chosen from the Appendix of the mentioned reference books, particularly –book 1.

REFERENCE BOOKS:

Pallapa Venkataram, Sunil Kumar Manvi, "**Communication Protocol Engineering**", PHI, 2004.
G. J. Holtzmann, "**Design and validation of Computer protocols**", Prentice hall, 1991 (available on web)
K. Tarnay, "**Protocol Specification and Testing**", Plenum press, 1991

ELECTIVE – II

CRYPTOGRAPHY AND NETWORK SECURITY

Subject Code	: **10EC023**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hrs	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Overview: Services, Mechanisms and attacks, OSI security architecture, Model for network security.

Classical Encryption Techniques: Symmetric cipher model, Substitution techniques, Transposition techniques, Rotor machine, Steganography, Problems.

Block Ciphers and DES (Data Encryption Standards): Simplified DES, Block cipher principles, DES, Strength of DES, Block cipher design principles, Block cipher modes of operation, Problems.
Public Key Cryptography and RSA: Principles of public key cryptosystems, RSA algorithm, Problems.

Other Public Key Crypto Systems and Key Management: Key management, Diffie-Hellman key exchange, Elliptic curve arithmetic, Elliptic curve cryptography, Problems.

Message Authentication and Hash Functions: Authentication requirements, Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MAC's, Problems.]

Digital Signature and Authentication Protocol: Digital signature, Authentication protocols, Digital signature standard.

Authentication Applications: Kerberos, X.509 authentication service, Kerberos encryption technique, Problems.
Electronic Mail Security: Pretty good privacy, S/MIME, Data compression using ZIP, Radix-64 conversion, PGP random number generator.

IP Security: Overview, IP security architecture, Authentication header, ESP (encapsulating security pay load), Security associations, Key management, Problems.)
Firewalls: Firewall design principles; Trusted systems, Problems.
REFERENCE BOOKS:

William Stallings, "**Cryptography and Network Security"**, 3rd edition, Pearson Education (Asia) Pvt. Ltd./ Prentice Hall of India, 2003.
C. Kaufman, R. Perlman, and M. Speciner, "**Network Security: Private Communication in a Public World**", 2nd edition, Pearson Education (Asia) Pvt. Ltd., 2002.
Atul Kahate, "**Cryptography and Network Security**", Tata McGraw-Hill, 2003.
Eric Maiwald, "**Fundamentals of Network Security**", McGraw-Hill, 2003.

Wireless and Mobile Networks

Subject Code	: **10EC131**	IA Marks	: 50
No. of Lecture Hours/Week	: 04	Exam Hours	: 03
Total No. of Lecture Hours	: 52	Exam Marks	: 100

Review of fundamentals of wireless communication and networks. Wireless communication channel specifications, wireless communication systems, wireless networks, switching technology, communication problems, wireless network issues and standards.

Wireless body area networks (WBAN). Properties, network architecture, components, technologies, design issues, protocols and applications.

Wireless personal area networks. Architecture, components, requirements, technologies and protocols, Bluetooth and Zigbee.

Wireless LANS. Network components, design requirements, architectures, IEEE 802.11x, WLAN protocols, 802.11 p and applications.

WMANs. IEEE 802.16, architectures, components, WiMax mobility support, protocols, broadband networks and applications. WWANs. Cellular networks, Satellite networks, applications.

Wireless adhoc networks. Mobile adhoc networks, Sensor networks, Mesh networks, VANETs. Research issues in wireless networks.

References:

1. S. S. Manvi, M. S. Kakkasageri, "**Wireles and Mobile Network concepts and protocols**", Wiley, First edition, 2010.
2. P. Kaveh, Krishnamurthy, "**Principles of wireless networks: A unified approach"**, PHI, 2006.

Iti Saha Mishra, **Wireless communication and networks 3G and beyond"**, MGH, 2009

4. Mullet, "I**ntroduction to wireless telecommunication systems and networks"**, Cengage, 2009.
5. Yi-Bing Lin, Imrich Chlamtac, "**Wireless and mobile network architectures"**, Wiley, 2009

REAL TIME OPERATING SYSTEMS

Subject Code	: **10EC126**	IA Marks	: 50
No. of Lecture Hours /week	: 04	Exam Hours	: 03
Total no. of Lecture Hours	: 52	Exam Marks	: 100

Introduction to Real-Time Embedded Systems: Brief history of Real Time Systems, A brief history of Embedded Systems.

System Resources: Resource Analysis, Real-Time Service Utility, Scheduling Classes, The Cyclic Esecutive, Scheduler Concepts, Preemptive Fixed Priority Scheduling Policies, Real-Time OS, Thread Safe Reentrant Functions.

Processing: Preemptive Fixed-Priority Policy, Feasibility, Rate Montonic least upper bound, Necessary and Sufficient feasibility, Deadline – Monotonic Policy, Dynamic priority policies.

I/O Resources:
Worst-case Execution time, Intermediate I/O, Execution efficiency, I/O Architecture.
Memory:
Physical hierarchy, Capacity and allocation, Shared Memory, ECC Memory, Flash filesystems.

Multiresource Services:
Blocking, Deadlock and livestock, Critical sections to protect shared resources, priority inversion.

Soft Real-Time Services:

Missed Deadlines, QoS, Alternatives to rate monotonic policy, Mixed hard and soft real-time services.

Embedded System Components:
Firmware components, RTOS system software mechanisms, Software application components.

Debugging Components:
Execptions assert, Checking return codes, Single-step debugging, kernel scheduler traces, Test access ports, Trace ports, Power-On self test and diagnostics, External test equipment, Application-level debugging.

Performance Tuning:
Basic concepts of drill-down tuning, hardware – supported profiling and tracing, Building performance monitoring into software, Path length, Efficiency, and Call frequency, Fundamental optimizations.

High availability and Reliability Design:
Reliability and Availability, Similarities and differences, Reliability, Reliable software, Available software, Design trade offs, Hierarchical applications for Fail-safe design.

Design of RTOS – PIC microcontroller. **(Chap 13 of book Myke Predko)**

References:

"**Real-Time Embedded Systems and Components" ,** Sam Siewert, Cengage Learning India Edition, 2007.
" **Programming and Customizing the PIC microcontroller" ,** Myke Predko, 3rd Ed, TMH, 2008
"**Programming for Embedded Systems**", Dreamtech Software Team, John Wiley, 2008
"**Embedded Linux: Hardware, Software & Interfacing**" , Carig Hollabaugh, Pearson Education, 2009.