University of Pune
Department of Electronic Science

MSc ELECTRONIC SCIENCE

CREDIT SYSTEM

SYLLABUS

SEMESTER III AND IV

JANUARY 2009

Department of
Electronic Science

University of Pune
Department of Electronic Science

Syllabus for M.Sc. Electronic Science
(Credit System)

- The course is divided into four semesters and students are to complete 100 credits in four semesters.
- The Courses are categorized as of Core Theory, Practical, General Elective, Special Elective and Project/Internship.
- All Core Theory courses are compulsory.
- The Practical Courses at semester I are compulsory.
- The Student has to offer at least one of the semester II Practical Courses
- The student has to make a choice of **One** Special Elective Group from semester II.
- One Practical Course at semester III is compulsory for all.
- Another Practical course from semester III and Project/Internship are linked to the Special Elective Group.
- The theory and practical courses offered under the chosen group will be compulsory.
- Additional courses to complete the 100 credits can be chosen from among the General Elective Theory courses or courses offered by other departments of the University (subject to approval by departmental teaching committee)
- The grades for courses will be based on 50:50 weightage to Continuous Internal Assessment (CIA) and Semester End Examination (SEE)

Semester III — Credits

	Credits
Practical Courses	
EL – 301 Practical V Common Lab	**4**
EL – 302 Practical VI Special Lab	**4**
Core Theory Courses	
EL – 303 VLSI Design	**2**
EL – 304 Embedded System Applications	**2**
EL – 305 Digital Communication Technology	**2**
General Elective Courses	
EL – 351 Processor Architecture and Design	**2**
EL – 352 VHDL and Verilog : Testing and Verification	**2**
EL – 353 Mechatronics	**2**
EL – 354 DSP systems: Processors and Applications	**2**
EL – 355 Mobile Communication Systems	**2**
EL – 356 Data Communication	**2**
EL – 357 Fundamentals of MEMS Design and Fabrication	**4**
EL – 358 IC and Microsystems Packaging	**2**
EL – 359 Surface Mount Technology	**2**
Special Elective Group Courses	
Group 1	
EL – 311 CMOS Systems Design I : Circuits and Processes	**4**
EL – 312 CMOS System Design II: Mask layouts	**4**
Group 2	
EL – 321 Operating System and RTOS	**4**
EL – 322 Wireless Embedded System Design	**4**
Group 3	
EL – 331 Communication System Design	**4**
EL – 332 Microwave & Satellite Communication	**4**

EL—301   Practical V : Compulsory Lab   4

Experiments covering following aspects
(i)   Familiarization with contemporary CAD-VLSI tools
(ii)   VHDL coding and Logic/Timing simulations
(iii)   VLSI Mask Design examples
(iv)   Microprocessor/Microcontroller interfacing with MIMIC panels
(v)   PC based instrumentation
(vi)   Virtual instrumentation
(vii)   Digital communication system
(viii) Signal digitization and PCM
(ix)   MODEM principles, Error Detection and correction

**EL – 302   Practical VII: Special Lab   4
(Any one of the Special groups)**

SG 1 Microelectronics/VLSI Design

Experiments covering following aspects
(i)   Fabrication techniques: deposition, oxidation,
       Lithography etching, characterization, etc
(ii)   Analog ASIC Design Flow
(iii) Schematic circuit drawing and analysis
(iv)   Layout design
(v)   DRC and Circuit extraction
(vi)   Parasitic optimization

SG 2 Embedded System Applications

Experiments covering following aspects
(i)   Target board design
(ii)   Integrated Development Environment
(iii) Embedded system Applications
(iv)   Embedded system communication protocols
(v)   RTOS
(vi)   JAVA applets design and Web page design

SG 2 Communication Systems

Experiments covering following aspects
(i)   Use Spectrum Analyzer to measure signals & losses
(ii)   Measure of Reflection coefficients, (SWR), etc. of
       transmission lines, antennas
(iii) Time Domain Reflectometry using coaxial cables.
(iv)   Design & analysis of antenna using mini- NEC
(v)   RF vector Network Analyser (VNA) study through
       VSWR, Gain-phase , Smith chart plots, S-
       parameter measurements
(vi)   Antenna pointing and tracking
(vii) Retrieving and analyzing Satellite signals and
       understanding of the receiver chain.

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EL – 303   **VLSI Design**   **2**

Hierarchical design of VLSIs, interception levels, behavioral description, RTL, Logic circuit, gate, circuits, device, process.

The cost -volume trade-off, role of design center and foundry, design methodologies, custom and semicustom designs, standard cell, gate array, FPGA, CPLD and PLDs, FPGA Design Flow, ASIC Design Flow, Fault Modeling and Simulation

CAD VLSI tools, simulators for logic, timing, circuit, device and process optimization, Xilinx, Spice, Minmos, Suprem simulation tools, Layout design, assignment, partitioning, placement, global and channel routing, compaction and verification algorithms and tools, Layout design verifiers, mask pattern generators.

Text / Reference Books:

1.	Modern VLSI Design	W.Woulf, Pearson
2.	Principles of CMOS VLSI Design	N. H.E. West and K.Eshranghian, PHI
3.	Basic VLSI Design	D.A. Pucknell K. Eshraghian, PHI.
4.	Essentials of VLSI Design	K.Eshrangian, D.A. Pucknell and Ehrangian, PHI
5.	Integrated Circuit Engineering	Glasser, A.B Sharpe, S McGraw Hill Int.

Recommended Journals :

1.   IEEE Trans. On Electron Devices.
2.   IEEE Trans. On CAD of VLSL.
3.   IEEE Trans. On Semiconductor Manufacturing.

EL – 304   **Embedded System Applications**   **2**

Introduction to Embedded Systems characteristics, design metrics, requirements, trends, Microcontroller selection, IDE selection, Hardware / Software Co-design and operating system considerations

Interfacing Memory and I/O devices, Common peripherals and their interfacing, Data transfer schemes, programmed data transfer, synchronous and asynchronous transfer, interrupts, enabling, disabling, masking, prioritizing interrupts, Direct Memory Access (DMA) data transfer, Serial data transfer, Buses & protocols, I2C, CAN, FIREWIRE, USB, Bluetooth, Zigbee, IrDA etc

I/O devices for process control and instrumentation, data acquisition systems, Case studies: RF ID, Smart cards, PDA's, Consumer applications, Automotive control

Text / Reference Books:

1.	Computers as Components: Principles of Embedded Computer Systems Design	Wayne Wolf Morgan Kaufmann
2.	Microprocessors & Interfacing Programming & Hardware	D. Hall, McGraw Hill Int. Edition.
3.	Embedded Systems Design	Vahid F. Givargies John WILEY X SONS 2002
4.	Embedded Microcomputor System: Real Time Interfacing	J.W. Valvano, Brooks/Cole, 2000.
5.	The Art of Designing Embedded Systems	Jack Ganssle, Newnes, 1999.
6.	Embedded Systems- Architecture, Programming and Design	2. Raj Kamal, TMH 2003

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EL – 305   **Digital Communication Technology**   **2**

Information theory, Shanon's definition of information, entropy, capacity of a channel, Shanon's theorem.

Digital communication principles, FDM, TDM and WDM systems. Sampling and digitization of analog signals, PCM, delta modulation, transmission coding, code compression, Compading, CODECs, error detection and correction codes, cyclic codes, convolution codes, data security, encryption/decryption algorithms.

Line coding, NRZ, RZ, AMI, Manchester, HDB3 coding, Block codes, clock extraction and synchronization.

Data communication, DTE, DCE, MODEMs, ASK FSK, PSK, DPSK, QPSK, MSK.GMSK, M-ary FSK, QAM, Spread Spectrum modulation DS-SS, FH-SS

FDMA, TDMA and CDMA techniques.

Text / Reference Books:

1.	Communication Systems Analog and Digital	R.P. Singh, S.D. Sapre. TMH.
2.	Analog and Digital Communication Systems	Martin S. Roden. Discovery Press
3.	Fundamentals of Error Correcting Codes	W. Cary Huffman, V Pless. Cambridge University Press
4.	Electronic Communication Systems	W. Tomasi, Pearson
5.	Wireless Communications Principles and Practice	T.S.Rappaport. Pearson Edu.Asia.
6.	Principles of Communication	Taub and Schilling, TMH

EL – 351   **Processor Architecture and Design**   **2**

Subsystem design concepts, design of multiplexer, parity generator leaf cell, adder, subtractor, multiplier, ALU, datapaths and control unit design

Data path concepts, Design of Data Paths and control units, Processor architecture, Timing and Control unit designs, CISC and RISC architectures, ALU design, Pipelined processors, pipelined instruction execution, Scalable processors
Architectural concepts of Intel 8086 family including 80286, 386,486, Pentium, Memory and IO systems

Text / Reference Books:

1.	Logic and Computer Design Fundamentals	M. Mano, C.R. Kime, Pearson Edu
2	Modern Processor Design	J. P. Shen, M.H. Lipasty, Tata McGraw-Hill
3.	Computer organisation	C. Hamacher, Z, Vranesic, S. Zaki, TMH
4.	Computer Organisation and design	D.A. Patterson, J.L. Henessye, Morgan Kaufmann
5.	Computer Architecture and Organisation	Hayes, McGraw Hill

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EL – 352   VHDL and Verilog : Testing and Verification   2

Hardware description languages for VLSI design, VHDL and Verilog, programming and subsystem design concepts, design of multiplexer, parity generator leaf cell, adder, subtractor, multiplier, ALU, datapaths and control unit design

Fault Modeling and Simulation, Functional testing, Design for testability, Scan based designs, Boundary scan standards (JTAG), Signature analysis, Built in Self test , Built in logic block observer

Text / Reference Books

1.	CMOS VLSI Design	N.H.E. Weste, K. Eshranghian, Addison Wesley
2.	Digital Design Principles	J. Wakerley, Prentice Hall of India
3.	Digital Sytems testing and testable design	Miron Abromovici, Melvin Breuer, Arthur Freedman, Jaico Publishing House
4.	VHDL	D. Perry, MaGraw Hill Int. Edition.

EL – 353   **Mechatronics**   **2**

Mechanical Systems Components, Dynamics and modeling, Mechanical systems and design: mechatronic approach, control, design process, Load conditions, flexibility, man machine interface

Sensors and instrumentation systems, embedded systems, Drives and actuator, Control Devices, Linear systems, Rotational Drives, Motion Converters – Levers, Gears, pulleys, screws, electromechanical drives

Motion control devices and circuits: pilot devices, control circuits and load circuits, fuses and circuit breakers, enclosures, conductors, lockout, tag out safety

Robots and other motor control systems: Types of robot control, Types of Robot programs,
CNC MACHINES, Parts of a Robot, robot actuators, IO modules

Case studies: Autofocus cameras, Floppy/CD ROM drives, Industrial Robots

Text /Reference Books:

1.	Mechatronics	Bradley, Dawson, Burd and Loader Nelson Thornes
2.	Industrial Electronics	Thomas Kissel Prentice Hall of India
3.	Robotic Engineering	R.D. Klafter, T.A. Chmielewski, M.Negin, PHI

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EL – 354   DSP system: Processors and Applications   2

DSP processor architecture, Multiplier and acuumulator, ALU, Barrell shifter, Memory and Cache registers, Buses, Peripherals, Circular buffers and other specialized hardware,.

Study of architecture, assembly language and specific applications of TI, AD and Motorola DSP processors

Applications for filtering, modulation, demodulation, Image enhancement and compression, motion control and positioning, Radar, Sonar, Noise reduction and Echo cancellation, Speech recognition and interference rejection

Text / Reference Books:

1.	Digital Signal Processing: Principles, algorithms and applications	J.G. Proakias and D.G. Manolakis, PHI
2	VILSI Digital Signal Processing Systems: Design and Implementation	K.K.Parhi, John Wiley , 1999
3.	Digital Signal processing: Hands on approach	C. Schuler and M. Chugani, TMH
4.	Theory and applications of Digital Signal Processing	L.R. Rabiner and B. Gold, Prentice Hall
5.	Discrete Time Signal Processing	A.V. Oppenheim and R.W. Schaffer, PHI

EL – 355   **Mobile Communication Systems**   **2**

Mobile communication systems, cellular concepts, role of base station and mobile switching centers, Hands-off considerations, frequency reuse, roaming, SMS, GSM, GPRS, CDMA and EDGE, Speech coding techniques, Vocoders.

ATM, SDH, SONET, Physical Layers, Interfaces, Signalling, IP routing, MPLS, VPN, Metropolitan Ethernet Services, Control plane and forwarding plane, architecture.

Telecommunication Network management overview, Wireless Network fundamentals, OSI model layers, architecture, broadband systems.

Introduction to Emerging technologies IP multimedia systems, GSM/CDMA, Wi-Fi, Wi-Max, Blue Tooth, 3G/4G & Next Gen. Networks (NGN), IP/ mobile TV, Long Haul systems.

Text /Reference Books:

1.	Telecommunication	T.Vishwanathan, PHI
2.	Mobile Cellular Telecommunications,	W.C.Y. Lee, McGraw Hill
3.	Future Developments in Telecommunication,	J. Martin, Prentice Hall

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EL – 356   **Data Communication Systems**   **2**

Data communication networks and services, application and layered architecture, OSI model, IEEE 802.3 and IEEE 802.11, Network topologies, LAN and MAC, Data link control, Bridging, switching, addressing, Transmission systems, circuit switching networks, routing, signaling and traffic management

Packet switching networks, Internetworking – Repeaters, bridges, routers and gateways.Introduction to Routing protocols TCP/IP and Internetworking, TCP/IP protocol suite TCP/IP Sockets Client-Server, computing, Name Service, Application protocols over TCP/IP, IPV6, network architectures and protocols, Web server, SMIP server, DNS server, network security, ATM Networks, ISDN, BISDN, VoIP, VoDSL, VPN, MPLS-VPN, Metro-E network, VOIP.

High speed LANs – Fast and Gigabit Ethernet, FDDI. Wireless LANs. Bluetooth, Wi-Fi WLAN, WAP and Mobile computing.

Text/Reference Books:

1.	Data Networks	D. Bertsekas, R. Gallagher
2.	Computer Networking	Tanenbaum, PHI
3.	Computer Networks	U.Black, PHI

EL – 357 Fundamentals of MEMS Design and Fabrication

4

Pre-requisite: Microfabrication processes and Techniques

Overview of MEMS and Microsystems, Materials for MEMS and Microsystems: silicon, Silicon compounds, silicon piezoresistors, polymers, packaging materials, material characterization techniques - SEM, optical microscopy, XRD, IR, ESCA, SIMS,

MEMS Technology: Surface micromachining, Bulk micromachining, Deep Reactive Ion Etching

Engineering Mechanics for Microsystems design: Bending of thin plates, mechanical vibrations, thermomechanics, fracture mechanics, thin film mechanics,

Overview of finite element stress analysis
Scaling laws in miniaturization: scaling in geometry, scaling in electrostatic forces, scaling in electromagnetic forces, scaling in electricity
MEMS Design: Design considerations, Process design , Mechanical design, Mechanical design using finite element method, MEMS Design Analysis,

Computer Aided Design: What is CAD, CAD package for Microsystems, how to choose CAD package, Study of Coventorware /Intellisuite: 2D Process Visualizer, 3D Visualizer, Process modeling, device layout, cross-section viewing, photomask generation,

Design examples (any two in details): accelerometers, gyroscopes, infrared sensing array, RF MEMS, and Optical MEMS.
Reliability Overview
Design Rules and DRC

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Text / Reference Books:

1.	An Introduction to Microelectromechanical Systems Engineering	Nadim Maluf
2.	The Micromachined Transducers Sourcebook,	Gregory T.A. Kovacs, McGraw-Hill, Inc., 1998.
3.	Microsystem Design	Stephen D. Senturia, , Kluwer Publishers, 2001
4.	Fundamentals of Microfabrication	Marc Madou

EL – 358 IC and Microsystems Packaging   2

Numbers in the breacket indicate number of lectures

Introduction: Package function and hirarchy, evolution of packages, PWB, SMT and Hybrid Circuits, Technology drivers, Single chip packages, Multichip Modules Introduction to Packaging Technologies, Silicon Effenciency and other packaging parameters

Package Design Considerations: Electrical design considerations: Receivers and and Transmitter attributes, Signal distribution, Power distribution, Noise containment, Low loss transmission systems, Package modeling, Wiring and terminals: Wiring hiriachy, Wiring models, Rent's rule, Package wirability issues, Thermal design: Thermal design basics and its considerations, Measurements, Cooling methods and issues, Introduction to issues in package reliability: Environmental effects, Thermal mismatch and fatigue, Types of thermal failures, Other assorted failure proceses

Packaging Processes: Process description, process and reliability issues, applications for: C4 and Flip chip, Chip bonding, Wire Bonding, Tape Automated Bonding (TAB), Sealing

Ceramic Packages: Materials and fabrication processes for Alumina ceramic packages and Low Temperature Ceramic packages, Thick film paste technology, Post fire processes, Brazing, CBGA, Concepts of integrated ceramic packaging

Plastic Packages: Types of plastic packages, Comparison with ceramic packages, Moulding compounds and lead frames, Moulding processes, Applications and future trends

Thin Film Packages: Thin film materials and processes, Comparison with Thick film packages, Emerging technologies and trends

Polymers in Packaging: Polyimides: Types in use, usage, applications and comparison, Polymeric dielectrics, Photosensitive polymides and epoxies

MEMS Packaging Issues and Solutions: Types of MEMS devices and their packaging needs, Contmporary packaging solutions

Packaging Summary and Future
Future trends in microelectronics and MEMS and the packaging needs, Application driven solutions

Text / Reference Books:

1.	Microelectronics Packaging Handbook, Parts I, II, III	Rao R. Tummala, Eugene J. Rymaszewski and Alan G. Klopfenstein
2.	Micro- and Opto- Electronic Materials and Structures, Volume I and II	Ephraim Suhir, Y. C. Lee and C. P. Wong
3.	The Electronic Packaging Handbook	Glenn R. Blackwell
4.	Flip Chip Technologies	John L. Lau
5.	Ball Grid Array Technology	John L. Lau
6.	Electronic materials Handbook, Volume 1: Packaging	Merrill L. Minges,
7.	Multi layered low temperature co fired ceramic (LTCC) Technology,	Yoshihihiko Imanaka

EL – 359   Surface   Mount   Technology   2

Types of Surface Mounting, Benefits of Surface Mounting, Surface Mount Components, Resistors, capacitors, transistors, SOICs and SOPs, BGA's CCGA, PBGA, TBGA Substrate Materials: Ceramic, Porcelain zed Steel, Graphite Epoxy Constraining Core Substrates Compliant Layer Substrates,   Glass   Epoxy   Substrates

SMT Equipment: Component Placement, Pick-and-Place , Solder Paste Screen Printer, Curing/Baking Oven, Reflow Soldering, Cleaning, Wave Soldering

Quality   Control,   Inspection   Repair,   and   Testing Statistical Quality Control, Solder Joint Inspection, Visual Inspection, Automated Inspection, Repair Equipment and Processes, Assembly Testing, Fixtures for ATE Testing

Text/Reference Books:

1.	Surface Mount Technology: Principles and Practice, 2nd Edition	Ray Prasad ISBN 0-412-12921-3
2.	Electronics Manufacturing Processes,	Thomas L. Landers, et al., 1994, ISBN: 0-13-176470-5
3.	Electronic Assembly Fabrication,	Charles Harper, McGraw-Hill, 2002

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EL-311 : CMOS Systems Design I : Circuits and Processes 4

Introduction : Typical Chip / Layout Structures, Substrates And Wells, Soft Connects / Multiples Stamps, Chip Development Flow: From Product Definition To Sales, Component Of Cost, Die Size And Yield, Key Design Parameters, The Quad Model.

Introduction To CMOS Processes : Basic Processing Steps (Doping, Photolithography, Etching, Deposition), CMOS Inverter Cross Section, MOS Device Design Equations, Electrical Interaction Of Layers, NMOS And PMOS Cross Section And Operation.

Circuits : R-C Circuits And Single Transmission Line, Metal Line Resistances And Capacitance, Simple Static CMOS Gates, Inverting And Non-Inverting Gates, CMOS Inverter, Complex Static CMOS Gates, Special CMOS Gates.

Circuit Characterization And Performance Estimation : Pull Up To Pull Down Ratio, Correspondence Of Design Parameters With Specifications, Switching Characteristics, Transistor Sizing, Power Dissipation, Design Margining, Scaling Of Device Dimensions.

Special Topics : Drawn Vs Actual Geometries, Bent Gates, Self Heating, Electromigration, EDS And NACS, Latch-Up, Hierarchy, CAD Tools.

Text / Reference Books:

1.	CMOS Circuit Design, Layout and Simulation,	R.Jacob Baker, Harry W. Li, David E. Boyce, PHI
2.	Principles Of CMOS VLSI Design : A Systems Perspective	Neil Weste, Kamran Eshraghian And Michael Smith, Addison Wesley.
3.	Digital Integrated Circuits	Jan M.Rabaey, Prentice Hall Of India, New Delhi.
4.	Basic VLSI Design	D.A. Pucknell And Kamran Eshraghian, PHI.
5.	"VLSI Technology"	S.M.Sze, TMH

EL-312 : CMOS System Design II : Mask Layouts   4

Layouts I : Stick Diagrams, Colour And Monochrome Codes In Stick Diagrams, Geometric Layout/ Process Design Rules, Layout Of Basic Cells. Techniques Commonly Used To Reduce Si Areas In Layouts.

Layouts II :   Sample Layout, Layout Methodology And Quality Guidelines, Diffusion Capacitance, Matched / Standard Cells.

Layouts III : CMOS Logic Gate Design, Mask Layout Designs For NMOS/CMOS, NAND, NOR Gates, 2 Input Multiplexer, Layout Optimization For Performance, Clocking Strategies, I/O Structures.

Layout IV :   Extracting Circuits From Layout, Split Gates, Cell Layout, Schematic And Layout Transistor Densities.

Mixed Signal Circuits and Layouts: Nonlinear Analog Circuits, Dynamic Analog Circuits, Data Converter Fundamentals, DAC and ADC.

	Text / Reference Books:	
1.	CMOS Circuit Design, Layout and Simulation,	R.Jacob Baker, Harry W. Li, David E. Boyce, PHI
2.	Principles Of CMOS VLSI Design : A Systems Perspective	Neil Weste, Kamran Eshraghian And Michael Smith, 2nd Edition, Addison Wesley, 2001.
3.	Digital Integrated Circuits	Jan M.Rabaey, Prentice Hall Of India, New Delhi.
4.	Basic VLSI Design	D.A. Pucknell And Kamran Eshraghian, PHI.
5.	"VLSI Technology"	S.M.Sze, TMH

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EL – 321   **Real Time Operating Systems**   **4**

Introduction to Operating Systems, Process Management & Inter Process Communication, semaphores, conditional critical regions, event queues, deadlock, processor management, scheduling algorithms, queuing system model,Memory management, I/O subsystem, File System Organization, POSIX Thread ProgrammingReal-time,

Hard/soft real time, Static scheduling, Dynamic scheduling, functional decomposition, Hardware-software trade-offs in embedded system. Distributed operating systems concept, file systems, mode of computation, load balancing, event ordering, synchronization, distributed mutual exclusion, drinking philosophers problem, deadlocks in distributed systems. Resource sharing, Priority inheritance and priority ceiling protocols, stack resource protocol, Performance Metrics of RTOS

Overview of Other RTOS/EOS, Hand held OS, Porting RTOSLinux & RTLinux Internals, Programming in Linux & RTLinux, Programming in Linux, Shell programming, System Programming, Programming in RT Linux, Configuring & Compiling RTLinux

Text / Reference Books:

1.	Real-Time Systems	Jane W. S. Liu, Prentice-Hall,
2.	Real-Time Systems -- Scheduling, Analysis, and Verification.	Cheng A.M.K. Wiley
3.	Operating Systems Concepts.	Silberschatz A, et al , Wiley
4.	Operating Systems: Design and Implementation.	A. Tanenbaum & A. Woodhull, Prentice-Hall
5.	Embedded Linux: Hardware, Software, and Interfacing	Dr. Craig Hollabaugh

EL 322   **Wireless Embedded Systems Design**   **4**

Wireless embedded system design: Protocol Design and Validation, Network Embedded Systems (Operating Systems and programming), Bluetooth and IrDA, LAN - IEEE 802.11, RFID, GSM and GPRS, Ubiquitous Computing

Wireless Sensor Networks and ZigBee : design implications of energy, and otherwise resource-constrained nodes; network self-configuration and adaptation; localization and time synchronization; collaborative processing, distributed feature extraction & programming sensor networks.

Protocol Design and Validation, Network Embedded Systems (Operating Systems and programming), The Internet Protocols: IPv4, IPv4 addressing, IP options, ICMP. Multicast: Multicast addressing and forwarding, IGMP, IPV6, Routing: Routing and forwarding, distributed routing information, RIP, OSPF, Transport over IP: UDP, TCP, SCTP, RTP., Application protocols : DNS, Telnet, FTP, HTTP., Web Programming : HTML , cascaded style sheets, JavaScript : Basics and objects in Java script, DHTML, CGI scripting, XML : defining data for web applications.

Communication Protocols for In-Vehicle Networks CAN (Controller Area Network), LIN (Local Interconnect Network), MOST (Media Oriented Systems Transport) and Flex Ray standards and protocols.

Text / Reference Books:

1.	TCP/IP Illustrated Volume 1, The Protocols	W.Richard Stevens, Pearson
2.	Operating Systems: Design and Implementation.	A. Tanenbaum & A. Woodhull, Prentice-Hall
3.	Web programming building Internet Applications	Chris Bates, II'nd ed, Wiley

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EL-331 Communication System Design   4

1. Amplitude modulation- DSSBC, DSBTC, SSB, VSB, AM demodulators, Coherent and incoherent demodulation, IC modulators and demodulators. Frequency modulation and demodulation, Broadband FM and FM stereo, Phase modulation and demodulation, Narrowband and broadband PM.
 Superheterodyne radio receiver,
Video signal transmission and reception using wire & wireless and optical fiber media.
Optical devices, LEDs, lasers, gratings, isolators, reflectors, etc.

2. Experiments for 2 credits.
    OTDR – concepts and measurements
    Simulation of losses, etc
    Optical spectrum analyzer study and use free space optics.

Text Books

1.	Television Engineering and Video systems	R.G.Gupta, TMH
2.	Principles of Communication Systems	Taub & Schilling.
3.	Electronic communication technique	Paul H.Young,Prentice Hall

Reference Books:

1.	Electronic Communication Systems,	G. Kenedy and D. Davis, TMH
2.	Electronic & Radio Engineering	Terman, F.E.
3.	Basic Television	Grob
4.	Communication Electronics	Roddy Coolen.
5.	Television and Video Engineering,	Dhake
6.	Television	Gulati
7.	Audio and Video Systems,	R.G.Gupta, TMH

EL-332 Microwave & Satellite Communication   4

Revision of Transmission concepts from RF and microwave antennas, propagation of em waves, ground, duct and sky wave propagation, Noise in communication systems, sources and types of noise.

Advanced topics on reflector antennas, Design consideration of parabolic dishes, wave guides and components, Microwave tubes, Microwave semiconductor devices, Microwave Links and Relay Station Tropo scatter links.

Detailed description of Satellite Communication: Basic Earth station, G/T figure of merit, prime focus offset feed, casse grain feed.   LNAs and HPAs, Ground communication equipment (GCE). down and up conversion,

Space craft antennas, transponders, etc.
Satellite Link Design
Intelsat, Inmarsat, Insat systems.

Text / Reference Books:

1.	Electronics Communication Systems	G.Kennedy & B.Davis, TMH Co.Ltd.
2.	Satellite Communication	T.Pratt & C.W.Bostian, John Wiley & Sons.
3.	Introduction to Satellite Communication	Scolnik

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Semester IV

EL – 401   Project/Internship   16

Project or internship related to the Special elective group

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EL – 411   Architecture and Design of VLSI System   4

Design & analysis of power supply networks : Voltage drop analysis modes, linear system solution techniques, Models for power distribution networks.

Noise considerations for digital IC's : Why has noise become a problem, Noise effects in digital designs, static noise analysis, electrical analysis, fixing noise problems.

Tools for chip package codesign : Digital system codesign issues, mixed signal codesign issues, I/O buffer interface standard.

Layout tools for analog integrated circuits and mixed signal systems on chip : Analog layout problems and approaches, Analog cell layout strategies, mixed signal system layout.

Design for Manufacturability in the Nanometer regime : Yield loss mechanisms, logic design for manufacturing, parametric design for manufacturing methodologies, yield-aware physical synthesis.

Mixed-signal noise coupling in SoC design : Mechanisms and effects of Mixed signal noise coupling, mixed signal noise measurement and validation, Application to placement and power distribution synthesis.

Text/Reference Books

1.	EDA for IC Implementation, Circuit Design and Process Technology	Louis Scheffer,Luciano Lavagno,Grant Martin
2.	The VLSI handbook, 2nd edition	Wai-Kai Chen
3.	CMOS Circuit Design, Layout and Simulation	R.Jacob Baker, Harry W. Li, David E. Boyce

EL 421   Architecture and Design of Embedded systems   4

Embedded processor architectures and microarchitectures. VLIW, EPIC, and SIMD, domain-specific embedded processors, configurable/reconfigurable embedded systems, HW/SW computing architectures. Single processor – coprocessor architecture, multiprocessor architectures, architectures for DSP and multimedia,

Constrained and optimized HW/SW system design, Behavioral description, Models and implementation of basic HW and SW components, their interfaces, synthesis and code generation, Scheduling of access, Prediction and analysis of constrained and optimized design, Partitioning algorithms and tools, Design for testability considerations.

Reconfigurable Computing, FPGA Architectures, FPGA Design Cycle, Coarse-grained Reconfigurable Devices and Multi-FPGA Systems, Integration Platforms and IP core based architectures, FPGA embedded processors Reconfigurable Computing Applications in bioinformatics, Image processing, Cryptography, Fault tolerant systems, etc

Text / Reference Books:

1.	Computers as Components: Principles of Embedded Computer Systems Design	Wayne Wolf Morgan Kaufmann
2.	Readings in Hardware/Software Co-Design	G. Micheli, R.Ernst, and W.Wolf, Morgan Kaufman
3.	Hardware/Software Co-Design Principles and Practice	J.Staunstrup and W.Wolf, Kluwer Academic.
4.	FPGA based system design	Wayne Wolf, Prentice Hall, 04
5	Advanced FPGA Design	Steve Kilts,Wiley Inter-Science

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EL- 431   Architecture and Design of Communication Systems   4

HFSS, NEC or any equivalent software for the study of antennas.

Wireless Standards : Advanced Mobile Phone Service, Global System for Mobile Communication, CDMA, General Considerations

Communication system design: Intersybol interference, Random processes and noise, sensitivity and dynamic range, Power efficiency of modulation schemes, noncoherent detection

Transmitter Architectures : Direct-Conversion Transmitters, Two-step Transmitters, Receiver Architectures : Heterodyne Receivers, Homodyne Receivers, Image-Reject Receivers, Digital-IF Receivers, Subsampling Receivers. . LNAs concepts and working: General Consideration, Input Matching, Bipolar LNAs, CMOS LNAs.Downconversion Mixers: General Considerations, Bipolar Mixers, CMOS Mixers, Noise in Mixers, Transceiver Performance Tests.

Case Studies: Motorola's FM Receiver, Philips' Pager Receiver, Philips' DECT Transceiver, Philips'DECT Transceiver, Lucent Technologies' GSM Transceiver, Philips' GSM Transceiver.

RF Synthesizer Architectures: Integer-N Architecture, Fractional-N Architecture, Dual Loop Architectures, Direct Digital Syntehsis, Phase-Locked Loops : Basic PLL, Charge-Pump PLLs, , Noise in PLLs, Phase Noise at Input, Phase Noise of VCO, Frequency Multiplication.

Artificial intelligence, navigation using GPS, astronomical

techniques relevant to communication.

Text/Reference Books:

1.	Multi-Standard CMOS Wireless Receivers: Analysis and Design	Xiaopeng Li, Ismail, Mohammed, Springer Vol. 675
2.	Wireless Communications Systems and Networks	Mohsen Guizan, Springer, 2004
3.	GPS for geodecy	P.J.G. Teunissen A. Klensberg
4..	GPS Inertial navigation,	Mohinder S. Krewal, L.R.Weill, Agnus P. Andhen

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