Appendix – 1

M.Tech. I(EC), I Semester (VLSI & Embedded Systems)									
Sr. No.	Course Name	Code	Teaching Scheme			Credit	Examination Scheme			Total
			L	T	P		Theory	Tutorial	Practical	
1	DIGITAL VLSI DESIGN(NEW)	EC 609	3	0	0	3	100	--	--	100
2	MOS DEVICES AND TECHNOLOGY(NEW)	EC 611	3	0	0	3	100	--	--	100
3	EMBEDDED SYSTEMS(NEW)	EC 613	3	0	0	3	100	--	--	100
4	VLSI LAB - I(NEW)	EC 615	0	0	8	4	--	--	100	100
5	Elective I	EC 6XX	3	0	0	3	100	--	--	100
6	Elective II	EC 6XX	3	0	0	3	100	--	--	100
Total			15	0	8	19	500	--	100	600
Total Contact Hours per week: 23										

LIST OF SUBJECTS FOR ELECTIVE I & II:	
(01) RF Circuits & Systems	EC601
(02) Advance DSP	EC605
(03) Information Theory & Coding	EC619
(04) VLSI Technology	EC617
(05) Hardware Description Language	EC623
(06) Device Modeling & Simulation	EC625
(07) Probability and Random Processes	EC629

Appendix 2

M. Tech. I (EC) [VLSI/CS] Semester I	L	T	P	C	
EC609:DIGITAL VLSI DESIGN(NEW)	3	0	0	3	

INTRODUCTION TO VLSI DESIGN	**(05 Hours)**
Historical Perspective, Design Hierarchy, Concepts Of Regularity, Modularity And Locality, VLSI Design Styles, VLSI Design Flow,Computer-Aided Design Technology	
MOS INVERTER	**(06 Hours)**
Static Characteristics: Introduction, Resistive Load Inverter, Inverters With N Type MOSFET Load, CMOS Inverter, Switching Characteristics And Interconnect Effects, Introduction, Definitions And Calculations Of Delay Times, Inverter Design With Delal Constraints, Estimation Of Interconnect Parasites, Calculation Of Interconnect Delay, Switching Power Dissipation Of CMOS Inverter	
CIRCUIT CHARACTERIZATION AND PERFORMANCE ESTIMATION	**(06 Hours)**
Delay Estimation, Logical Efforts And Transistor Sizing, Power Dissipation, Interconnect, Design Margin, Reliability	
COMBINATIONAL AND MOS SEQUENTIAL LOGIC CIRCUITS	**(06 Hours)**
CMOS Logic Circuits, Complex Logic Circuits, Behavior Of MOS Logic Elements, SR Latch Circuit, Clocked Latch And Flip-Flop Circuits, CMOS D-Latch And Edge-Triggered Flip-Flop	
DYNAMIC LOGIC CIRCUIT	**(06 Hours)**
Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, Dynamic And High Performance Dynamic CMOS Circuit	
DIGITAL SUBSYSTEM DESIGN	**(13 Hours)**
Semiconductor Memory Design, Schmitt Trigger, Multivibrator Circuit, Digital Phase Locked Loop, Adders, Multipliers And Shifters	
	(Total Contact Time:42 Hours)
BOOKS RECOMMENDED	
1. Kang and Leblebici,"CMOS Digital Integrated Circuits: Analysis and Design", Tata McGraw-Hill, 3rd Edition, 2003	
2. Baker R. Jacob, Li H. W. & Boyce D. E.,"CMOS Circuit Design, Layout And Simulation", Prentice-Hall Of India, 2nd Edition, 1998	
3. Jan M. Rabey, Anantha Chandrakasan, Borivoje Nikolic, "Digital Integrated Circuit",Pearson Education, 2nd Edition, 3rd Indian Reprint, 2004	
4. Weste and Harris,"CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 3rd Edition, 2002	
5. Pucknell and Eshraghian: "Basic VLSI Design", Prentice Hall of India, 3rd Edition, 2003	

M. Tech. I (EC) [VLSI] Semester I	L	T	P	C	
EC611:MOS DEVICES AND TECHNOLOGY(NEW)	3	0	0	3	
INTRODUCTION TO QUANTUM MECHANICS					**(09 Hours)**
Principles Of Quantum Mechanics, Schrodinger's Wave Equation, Application Of Schrodinger Wave Equation, Electrical Conduction In Solid, Density Of State Function, Statistical Mechanics					
PHYSICS OF SEMICONDUCTOR					**(12 Hours)**
Semiconductor In Equilibrium, Carrier Transport Phenomena, Non Equilibrium Excess Carries In Semiconductor					
PN JUNCTION DIODE					**(05 Hours)**
PN Junction Current, Small Signal Model, Generation And Recombination Current, Junction Break Down					
FUNDAMENTAL OF MOSFET					**(08 Hours)**
Metal Semiconductor And Hetero Junctions, Two Terminal MOS Structure, CV Characteristics, MOSFET Operation, Frequency Limitation					
ADVANCE MOS DEVICES					**(04 Hours)**
FABRICAION OF MOSFET					**(04 Hours)**
Fabrication Process Flow, CMOS N-Well Process, Layout Design Rules, MASK Layout, Stick Diagram					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Donald Neaman,"Semiconductor Physics and Devices",McGraw Hill,Third Edition,2007					
2. Sze S. M.,"Semiconductor Devices, Physics And Technology",John Wiley and Son s 2nd Edition,2002					
3. Sze S. M.,"Physics of Semiconductor Devices", John Willey 2nd Edition,1981					
4. Streetman,"Solid State Electronics Device",HI,2000					
5. Baker R. Jacob, Li H. W. & Boyce D. E.,"CMOS Circuit Design, Layout and Simulation",Prentice-Hall Of India,2nd Ed.,1998					

डिपार्टमेंट ऑफ़ इलेक्ट्रॉनिक्स इंजीनियरिंग
DEPARTMENT OF ELECTRONICS ENGINEERING
सरदार वल्लभभाई नेशनल इंस्टिट्यूट ऑफ़ टेक्नोलॉजी, सूरत
SARDAR VALLABHBHAI NATIONAL INSTITUTE OF TECHNOLOGY, SURAT

M. Tech. I (EC) [VLSI/CS] Semester I	L	T	P	C	
EC613:EMBEDDED SYSTEMS(NEW)	3	0	0	3	

INTRODUCTION TO EMBEDDED SYSTEMS	(04 Hours)
Overview, Categories, Characteristics, Application Areas, Process of Embedded System Development,RICS Vs SICS Architecture, RTOS Overview of 8 Bit Microcontrollers Family	
OVERVIEW OF 8 BIT MICROCONTROLLER	**(06 Hours)**
Brief Review Of 8 Bit Microcontroller, Programming, CPU Block Diagram, Memory Organization, Ports And Interfacing, High Speed Output, Interrupts, ADC, PWM, Timers, Watch Dog Timer, Serial Port, I/O Port	
ARM ARCHITECTURE	**(13 Hours)**
Resisters, Current Program Status Resister, Pipeline, Exception, Interrupt And Vector Table, Memory Map, Arm And Thumb Mode Memory Management Unit, Arm Architecture, Arm Architecture Revision, Cortex Processor Architecture	
ARM SOFTWARE DEVELOPMENT	**(05 Hours)**
Arm & Thumb Instruction Set: Data Processing Instruction, Branch Instruction, Load Store Instruction, Program Status Resister Instruction, Loading Constant, Stack Instruction, Conditional Execution	
'C' Programming ARM	**(05 Hours)**
Overview Of C Compiler, Basic 'C' Compiler, C Looping Structure, Resistor Allocation, Function Calls, Pointer Aliasing, Structure Arrangement, Bit Fields, Unaligned Data And Endianness, Division, Floating Point, Inline Function And Inline Assembly	
COMMUNICATION INTERFACE	**(09 Hours)**
RS 232, UART, USB, RS485, Infrared, Ethernet, IEEE802.11, Bluetooth, SPI, I2C, CAN	
	(Total Contact Time:42 Hours)
BOOKS RECOMMENDED	
1. Kenneth Ayala J., "8051 Microcontroller: Architecture, Programming & Applications", Thomson, 1st Edition, 2006	
2. Sloss and System, "ARM System Developer's Guide: Designing and Optimacy System Software",Elsevier, 2004	
3. Rajkama, "Embedded System Architecture, Programming and Design", Tata McGraw- Hill,2004	
4. Mazidi and Mazidi, Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems using Assembly and C", PHI, 3rd Edition, 2004	
5. Prasad K. V. K. K., "Embedded / Real-Time Systems: Concepts, Design And Programming", Dreamtech Press, 2005	

M. Tech. I (EC) [VLSI] Semester I	L	T	P	C	
EC615:VLSI LAB - I(NEW)	0	0	8	4	
01. Introduction Of IC Design And IC Layout Software Tool					
02. Realization Of MOS Characterizing					
03. CMOS Inverter VTC & Layout					
04. Introduction Of HDL Software Tool					
05. Implementation Of Array Sub System Using HDL					
06. Device Fabrication Simulation Using TCAD					
07. Realization Of MOS Capacitor And Its Simulation In Various Regions Of Operation					
08. Analysis Of Scaling Down On MOSFETS					
09. Implementation Of Multiple Gate MOSFETS					
10. 2D/3D Simulation Of Photonic Devices.					
11. Introduction To Embedded Software-Hardware Tool Chain (Complier, Debugger, Simulation, Hardware Kit)					
12. Writing Software (Assembly / C) For ADC / DAC, PWM, GPIO, Serial Port, USB, Interrupt RS485 Using 8 Bit Microcontroller & ARM7					

LIST OF SUBJECTS FOR ELECTIVE I & II:

M. Tech. I (EC) [CS/VLSI] Semester I	L	T	P	C	
EC601:RF CIRCUITS & SYSTEMS(NEW)	3	0	0	3	
INTRODUCTION					**(02 Hours)**
RF Behavior of Passive Components, Chip Components					
TRANSMISSION LINE ANALYSIS					**(03 Hours)**
Transmission Lines, Equivalent Circuit Representation, Theoretical Foundation, Circuit Parameters For A Parallel Plate Transmission Line, General Transmission Line Equation,Microstrip Transmission Lines, Terminated Lossless Transmission Line, Special Termination Conditions, Sourced And Loaded Transmission Line, Problems					
SMITH CHART					**(03 Hours)**
From Reflection Coefficients to Load Impedance, Impedance Transformation, Admittance Transformation, Parallel and Series Connection, Problems					
SINGLE- AND MULTIPORT NETWORKS					**(02 Hours)**
Basic Definitions, Interconnecting Networks, Network Properties And Application,Scattering Parameters-Definition And Meaning Of S- Parameters, Problems					
RF FILTERS DESIGN					**(06 Hours)**
Basic Resonator And Filter Configurations, Special Filter Realizations, Filter Implementation					
MATCHING AND BIASING NETWORKS					**(04 Hours)**
Impedance Matching using Discrete Components, Microstrip Line Matching Networks, Amplifier Classes of Operation & Biasing Networks, Problems solutions					
POWER DIVIDERS AND DIRECTIONAL COUPLERS					**(04 Hours)**
The T - Junction Power Divider, The Wilkinson Power Divider, The Quadrature (90°) Hybrid, Coupled Line Directional Couplers, Problems					
BASIC BLOCKS IN RF SYSTEMS					**(03 Hours)**
Receiver And transmitter Architectures, Low Noise Amplifier Design, Design And Implementation Of Various Mixers					
RF OSCILLATORS & SYNTHESIZERS					**(07 Hours)**
Basic Topologies, VCO And Definition of Phase Noise, Noise Power Trade-Off,Resonator Less VCO Design, Quadrature And Single-Sideband Generators, PLLS,Various RF Synthesizer Architectures And Frequency Dividers					
DESIGN ISSUES					**(04 Hours)**
Linearization Techniques, Power Amplifier Design, Integrated RF Filters					
MMIC					**(04 Hours)**
Materials, MMIC Growth, Thin Film Formation, Hybrid IC Formation					
					(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:
1. Ludwig Reinhold and Bretchko Powel, "RF Circuit Design", Pearson Education, Reprint 2004
2. Pozar M. David, "Microwave Engineering", John Wiley & Sons, Inc., 1999
3. Liao Samuel, "Microwave Devices And Circuits". Pearson Education, Second Reprint, 2006
4. Bhat Bharathi and Koul Shibon,"Stripline-Like Transmission Lines For MIC", New Age International, Reprint 2003
5. Razavi B., "RF Microelectronics", Prentice-Hall PTR,1998

M. Tech. I (EC) [CS/VLSI] Semester I	L	T	P	C	
EC605:ADVANCE DSP(NEW)	3	0	0	3	
REVIEW OF DISCRETE SIGNAL REPRESENTATION AND ANALYSIS					**(06 Hours)**
TIME AND FREQUENCY-DOMAIN DESIGN TECHNIQUES FOR IIR ANDFIR FILTERS					**(10 Hours)**
FIR And IIR Filter Specifications And Structure, FIR Filter Design- Window Method, Park- s Method, Frequency Sampling Method; Design Of IIR Digital Filters:Butterworth, Chebyshev And Elliptic Approximations. Low Pass, Band Pass, Band Stop And High Pass Filters, Bilinear Transformation Method, Adaptive Signal Processing					
EFFECT OF FINITE REGISTERS LENGTH					**(05 Hours)**
Number Representation, Quantization Error, Round-Off Error, Overflow Error, Limit Cycle, System Noise Behavior, Noise Filtering By LSI System, Noise In A Cascade Of 2nd Order Filter, Stability Of Linear Filter					
MULTIRATE TECHNIQUES					**(09 Hours)**
General Rate-Changing System, Integer-Factor Interpolation And Decimation And Rational-Factor Rate Changing, Efficient Multirate Filter Structures, Optimal Filter Design For Multirate Systems, Multi-Stage Multirate Systems, Over sampling D/As, Perfect-Reconstruction Filter Banks And Quadrature Mirror Filters					
APPLICATIONS OF DSP					**(12 Hours)**
Speech And Radar Signal Processing; Signal Detection, Spectral Analysis Using DFT,Active Noise Control, Musical Sound Processing, Digital FM Stereo Generation, Speech Processing, Discrete Multi-Tone Transmission Of Digital Data, Digital Audio Sampling Rate Conversion					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Salivahanapriya S,"Digital Signal Processing", Tata McGraw-Hill,2003					
2. Rabiner L. R. and Gold B.,"Theory And Applications Of Digital Signal Processing", Prentice Hall,1992					
3. Oppenheim A. V. and Schafer,"Discrete Time Signal Processing", Prentice Hall,1989					
4. Proakis John G. and Manolakis D.G.,"Digital Signal Processing: Principle, Algorithms And Applications", Prentice Hall,1997					
5. Mitra Sanjit K.,"Digital Signal Processing - A computer Based Approach", McGraw-Hill,2005					

M. Tech. I (EC) [CS/VLSI] Semester I	L	T	P	C	
EC619:INFORMATION THEORY AND CODING(NEW)	3	0	0	3	

INFORMATION THEORY	**(09 Hours)**
Review Of Probability Theory, Introduction, Measure Of Information, Average Information Content Of Symbols In Long Independent Sequences, Average Information Content Of Symbols In Long Dependent Sequences, Properties Of Entropy, Extension Of Zero Memory Source	
SOURCE CODING	**(07 Hours)**
Properties Of Codes, Uniquely Decodable Codes, Kraft's Inequality, Average Length Of A Code, Shannon's First Theorem, Shannon's Encoding Algorithm, Shanon-Fano Codes, Huffman's Codes, Arithmetic Codes, Code Efficiency And Redundancy	
COMMUNICATION CHANNELS	**(06 Hours)**
Introduction, Discrete Communication Channels, Continuous Channels, Entropy Functions And Equivocation, Mutual Information, Channel Capacity, Channel Efficiency And Redundancy, Special Channels, Shannon-Hartley Law And Its Implications	
BLOCK CODES AND LINEAR CODES	**(08 Hours)**
Single Parity Check Codes, Product Codes, Hamming Codes, Hamming Codes,Minimum Distance Of Block Codes, Linear Block Codes, Generator Matrices, Parity Check Matrices, Encoder, Syndrome And Error Detection, Minimum Distance, Error Correction And Error Detection Capabilities, Performance Of Small Signal Constellations,Hard-Decision And Soft Decision Decoding	
CYCLIC, BCH & CONVOLUTION CODES	**(12 Hours)**
Definition Of Cyclic Codes, Polynomials, Generator Polynomial, Encoding And Decoding Of Cyclic Codes, Generator And Parity-Check Matrices Of Cyclic Codes, Linear Algebra And Galois Field, Introduction To BCH Codes, Introduction To Convolution Codes,Introduction To Turbo Coding	
	(Total Contact Time:42 Hours)
BOOKS RECOMMENDED	
1. Abrahamson N.,"Information Theory and coding", McGraw-Hill Book Co.,1963	
2. Ranjan Bose,"Information theory, coding and cryptography",Tata McGraw-Hill,2nd Edition,2008	
3. Salvatore Gravano,"Introduction to Error Control Codes",Oxford University Press,1st Edition,2007	
4. Proakis J.J.,"Digital Communications", McGraw Hill,2nd Edition,1989	
5. Todd K.Moon,"Error Correcting Coding", Wiley India Edition,2006	

M. Tech. I (EC) [VLSI/CS] Semester I	L	T	P	C	
EC617:VLSI TECHNOLOGY(NEW)	3	0	0	3	

ENVIRONMENT FOR VLSI TECHNOLOGY	**(03 Hours)**
Clean Room And Safety Requirements, Wafer Cleaning Processes And Wet Chemical Etching Techniques	
IMPURITY INCORPORATION	**(05 Hours)**
Solid State Diffusion Modeling And Technology, Ion Implantation Modeling, Technology And Damage Annealing, Characterization Of Impurity Profiles	
OXIDATION	**(08 Hours)**
Kinetics of Silicon Dioxide Growth Both for Thick, Thin And Ultra thin Films. Oxidation Technologies In VLSI And ULSI, Characterization Of Oxide Films, High K And Low K Dielectrics For ULSI	
LITHOGRAPHY	**(04 Hours)**
Photolithography, E-Beam Lithography And Newer Lithography Techniques For VLSI/ULSI, Mask Generation	
CHEMICAL VAPOUR DEPOSITION TECHNIQUES	**(07 Hours)**
CVD Techniques For Deposition Of Polysilicon, Silicon Dioxide, Silicon Nitride And Metal Films, Epitaxial Growth Of Silicon, Modeling And Technology	
METAL FILM DEPOSITION	**(05 Hours)**
Evaporation And Sputtering Techniques, Failure Mechanisms In Metal Interconnects, Multi-Level Metallization Schemes	
PLASMA AND RAPID THERMAL PROCESSING	**(06 Hours)**
PECVD, Plasma Etching And RIE Techniques, RTP Techniques For Annealing, Growth And Deposition Of Various Films For Use In ULSI	
PROCESS INTEGRATION	**(04 Hours)**
NMOS, CMOS And Bipolar Circuits, Advanced MOS Technologies	
	(Total Contact Time:42 Hours)
BOOKS RECOMMENDED	
1. Chang C.Y. and Sze S. M.,"VLSI Technology",McGraw Hill,1996	
2. Ghandhi S. K.,"VLSI Fabrication Principles",John Wiley Inc.,New York,1983	
3. Sze S. M.,"VLSI Technology",McGraw Hill,2nd Edition,1988	
4. Stephen A. Campbell,"The Science & Engineering of Microelectronics Fabrication", Oxford University Press,2nd Edition,2001	
5. Peter Van Zant,"Microchip Fabrication: A Practical Guide To Semiconductor Processing", McGraw-Hill,4th Edition,2000	

M. Tech. I (EC) [VLSI] Semester I	L	T	P	C	
EC623:HARDWARE DISCRIPTION LANGUAGES(NEW)	3	0	0	3	

INTRODUCTION	**(10 Hours)**
Basic Concepts Of Hardware Description Languages, Hierarchy, Concurrency, Logic And Delay Modeling, Structural, Data-Flow And Behavioral Styles Of Hardware Description, Architecture Of Event Driven Simulators	
SYNTAX AND SEMANTICS OF VHDL	**(14 Hours)**
Syntax And Semantics Of VHDL, Variable And Signal Types, Arrays And Attributes, Operators, Expressions And Signal Assignments, Entities, Architecture Specification And Configurations, Component Instantiation, Concurrent And Sequential Constructs, Use Of Procedures And Functions, Examples Of Design Using VHDL	
SYNTAX AND SEMANTICS OF VERILOG	**(18 Hours)**
Syntax And Semantics Of Verilog, Variable Types, Arrays And Tables, Operators, Expressions And Signal Assignments, Modules, Nets And Registers, Concurrent And Sequential Constructs, Tasks And Functions, Examples Of Design Using Verilog, Synthesis Of Logic From Hardware Description	
	(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:	
1. Perry D.,"VHDL",Tata McGraw-Hill,2nd Edition,2000	
2. Bhaskar J.,"VHDL Primer",Pearson Education Asia,2001	
3. Navabi Z.,"VHDL",McGraw Hill International Edition,1998	
4. Palnitkar S.,"Verilog HDL: A Guide to Digital Design and Synthesis",Prentice Hall NJ,USA,1996	
5. Bhaskar J.,"Verilog HDL Synthesis - A Practical Primer",Star Galaxy Publishing,Allentown,2003	

M. Tech. I (EC) [VLSI] Semester I	L	T	P	C	
EC625:DEVICE MODELLING AND SIMULATION(NEW)	3	0	0	3	

DEVICE PHYSICS	**(05 Hours)**
The P-N Junction, Review Of Semiconductor Physics, The Built In Voltage, Depletion Width And Junction Capacitance, Diode Current /Voltage Characteristics, Minority Carrier Charge Storage.	
BIPOLAR TRANSISTORS	**(08 Hours)**
Current Gain, Gummel Plots And Output Characteristics, Recombination In The Emitter/Base Depletion Region, Charge Storage And Forward Transit Time, Cutoff Frequency, TTL Gates, Basic SPICE Models, Eber's-Moll And Gummel-Poon Model, Parameter Extraction, TTL Circuits.</DIV< TD>	
MOS TRANSISTORS	**(10 Hours)**
Threshold Voltage And Body Effect, Current / Voltage Characteristics, Short Channel Effect and Narrow Width Effect, Drain Induced Barrier Lowering, Channel Length Modulation, Hot Carrier Effects, Effective Mobility And Velocity Saturation, SPICE Models, MOS Inverter Circuits.	
SPICE SIMULATION	**(10 Hours)**
Analysis Of Complex Electronic Circuits, Simulation And Analysis Using Spice, AC/DC Operation, AC/DC Sensitivity, DC Sweep Transfer Function, Frequency Response, Feedback Control Analysis, Transient Response, Distortion And Spectral Analysis, Device Models, Simulation And Analysis Of Electronic Circuits And Systems.	
PROCESS SIMULATION	**(09 Hours)**
Oxidation And Chemical Vapor Deposition, Lithography And Etch, Ion Implantation And Diffusion, Alignment And Self Alignment, Isolation In MOS Processes, Electron Migration And Multilevel Metallization, The Silicon Gate CMOS Process, CMOS Design Layout Rules, Process Simulation	
	(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:	
1. Hodges D.A., Jacksonh.G.,"Analysis And Design Of Digital Integrated Circuits",McGraw-Hill International,2000	
2. Uyemura J. P.,"Introduction To VLSI Circuits And Systems",John Wiley And Sons,2004	
3. Taur Y. and Ning T.H. " Fundamentals of Modern VLSI Devices, ", Cambridge University Press, 2004	
4. Eshraghian K. and Weste N. H. E., "Principles Of CMOS VLSI Design – A Systems Perspective",Addison Wesley 2000	
5. Sze S. M.,"Physics Of Semiconductor Devices"John Willey, 2nd Edition,1981	

M. Tech. I (EC) [CS/VLSI] Semester I	L	T	P	C	
EC629:PROBABILITY AND RANDOM PROCESSES(NEW)	3	0	0	3	

INTRODUCTION TO PROBABILITY THEORY	**(05 Hours)**
Sets, fields, sample space and events, axiomatic definition of probability. Combinatorics,Joint and conditional probabilities, Independence, total probability, Bayes' rule	
RANDOM VARIABLES	**(12 Hours)**
Cumulative Distribution Function, Probability Density Function. Relation Between Probability And Probability Density, Joint Cumulative Distribution And Probability Density, Characteristic functions and moment generating functions, Average Value And Variance Of A Random Variable, Gaussian Probability Density, Error Function, Rayleigh Probability Density,Mean And Variance Of The Sum Of Random Variables, Correlation Between Random Variables, Central Limit Theorem, liner minimum mean square error and orthogonality principle, Chebysev inequality Sequences Of Random Variables, Convergence Of Sequences Of Random Variables. Weak law of large number.	
STOCHASTIC PROCESSES	**(10 Hours)**
Stationary, Nonstationary, Strict-Sense and Wide-Sense Stationary Processes, Gaussian Processes, Poisson Process and the Markov Process	
EXPECTED VALUES OF A RANDOM PROCESS	**10 Hours)**
The Mean Value, Autocorrelation, Autocovariance, Power Spectral Density, Joint Statistical Averages of Two Random Processes, Crosscorrelation And Crosscovariance, Ergodicity, Mean Square Continuity, Mean Square Derivative And Mean Square Integral Of Stochastic Processes, Ergodic Processes	
STOCHASTIC MODELING	**(08 Hours)**
Example of random processes: White noise process and white noise sequence, Gaussian process, Poisson process, Markov Process	
	(Total Contact Time:42 Hours)
BOOKS RECOMMENDED	
1. Papoulis,"Probability, Random Variables And Stochastic Processes", McGraw-Hill,4th Ed., 10th Reprint,2006	
2. Larson H. J. and Shubert B. O."Probabilistic Models In Engineering Science – Vol I, Random Variable And Stochastic Process, Vol II Random Noise Signals And Dynamic Systems",Wiley Publication,1st Ed.,1982	
3. Gardener W.,"Stochastic Processes", McGraw-Hill,1st Ed.,1986	
4. Montgomeri and Ruger,"Applied Statistics And Probability For Engineers",John Wiley, 1st Ed.,2006	
5. Hayes Monson H.,"Statistical Digital Signal Processing", John Wiley,1st Ed.,1996	
6. Alberto leon Gracia, Probability and Random processes for electrincal engineer,: 2nd Ed, PE india	

Appendix 1

M.Tech. I(EC), II Semester (VLSI & Embedded Systems)										
Sr. No.	Course Name	Code	Teaching Scheme			Credit	Examination Scheme			Total
			L	T	P		Theory	Tutorial	Practical	
1	ANALOG VLSI DESIGN(NEW)	EC 612	3	0	0	3	100	--	--	100
2	REAL TIME SYSTEMS(NEW)	EC 614	3	0	0	3	100	--	--	100
3	VLSI LAB - II(NEW)	EC 616	0	0	8	4	--	--	100	100
4	Elective III	EC 6XX	3	0	0	3	100	--	--	100
5	Elective IV	EC 6XX	3	0	0	3	100	--	--	100
6	Elective V	EC 6XX	3	0	0	3	100	--	--	100
Total			15	0	8	19	500	--	100	600
Total Contact Hours per week: 23										

LIST OF SUBJECTS FOR ELECTIVE III , IV & V	
Image Processing	EC602
Wireless Communication	EC604
Reconfigurable Computing	EC618
Microwave Integrated Circuits *[Pre-requisite:EC601]*	EC632
Optical Signal Processing	EC634
Ad-Hoc Networks	EC636
Low Power VLSI Design	EC622
Nanoelectronics	EC624
DSP Structures for VLSI *[Pre-requisite:EC605]*	EC626
VLSI System Design *[Pre-requisite:EC623]*	EC642
Testing and Verification of VLSI Circuits *[Pre-requisite:EC623]*	EC644

Appendix 2

M. Tech. I (EC) [VLSI/CS] Semester II	L	T	P	C	
EC612:ANALOG VLSI DESIGN(NEW)	3	0	0	3	
ANALOG CMOS SUB-CIRCUITS					**(09 Hours)**
Small Signal Model For MOS, MOS Switch, MOS Resistors, Current Sink/Source, High Input Impedance Current Mirrors, Differential, Cascode And Current Amplifiers Output Amplifiers, High Gain Amplifier Architectures					
CMOS OPERATIONAL AMPLIFIERS					**(09 Hours)**
Design Of CMOS Operational Amplifiers, Compensation, Comparators, Design Of Two Stage Op-Amps, Cascode Op-Amps, Simulation And Measurement Techniques					
HIGH PERFORMACE CMOS OP-AMPS					**(06 Hours)**
Buffered Op-Amps, High Speed/Frequency Op-Amps, Differential Output Op-Amps, Micro Power Op-Amps, Low Noise And Low Voltage Op-Amps					
SWITCHED CAPACITOR FILTERS					**(09 Hours)**
Switched Capacitor Circuits: Design And Analysis, Switched Capacitor Amplifiers, Switched, Capacitor Integrators, Z Domain Models, 1st And 2nd Order Switch Capacitor Filters, Higher Order Filters.					
D/A AND A/D CONVERTERS					**(09 Hours)**
Sample And Hold Circuits. Characterization Of DAC, Nyquist Rate, Parallel DAC, Extending Resolution Of Parallel DAC, Serial DAC, Characterization Of ADC, Serial ADC, High Speed ADC, Over Sampling Techniques					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. John D.A. and Martin K.,"Analog Integrated Circuit Design",Wiley,1997					
2. Razavi Behzad,"Design of Analog CMOS Integrated Circuit",Tata McGraw-Hill,2002					
3. Allen Philip and Holberg Douglas,"CMOS Analog Circuit Design",Oxford University Press,2002					
4. Gregorian R. and Temes G.C.,"Analog MOS ICs for Signal Processing", Wiley 1986					
5. Baker Jacob R., Harry W. Li and Boyce David E.,"CMOS: Circuit Design, Layout and Simulation",Wiley Interscience, 2003					

M. Tech. I (EC) [VLSI/CS] Semester II	L	T	P	C	
EC614:REAL TIME SYSTEMS(NEW)	3	0	0	3	

INTRODUCTION TO REAL TIME SYSTEMS	(10 Hours)
Hard Versus Soft Real Time Systems, Reference Models Of Real Time Systems, Operating System Services, I/O Subsystems, Network Operations Systems, Real Time Embedded Systems, Operating Systems Interrupt Routines In RTOS Environments, RTOS Task Scheduling Models, Interrupt Latency And Response Time, Standardization Of RTOS	
REAL-TIME SCHEDULING AND SCHEDULABILITY ANALYSIS	**(09 Hours)**
Task, Process And Threads, Commonly Used Approaches To Real Time Scheduling, Clock-Driven Scheduling, Priority Driven Scheduling Of Periodic Tasks, Hybrid Schedules, Event Driven Schedules, Earliest Dead Line First (EDF) Scheduling, Rate Monitoring Alog (RMA), Real Time Embedded Operating Systems: Standard & Perspective, Real Time Operating Systems: Scheduling Resource Management Aspects,Quasi-Static Determining Bounds On Execution Times	
INTER-PROCESS COMMUNICATION AND SYNCHRONIZATIONOF PROCESSES,TASKS AND THREADS	**(05 Hours)**
Multiple Process in An Application, Data Sharing By Multiple Tasks And Routines Inter Process Communication	
REAL TIME OPERATING SYSTEMS	**(09 Hours)**
Handling Resources Sharing and Dependencies Among Real Time Tasks, Resource Sharing Among real Time tasks, Priority Inversion, Priority Inheritance Protocol (PIP), Highest Locker Protocol (HLP), Priority Ceiling Protocol (PCP), Different Types of Priority Inversion Under PCP, Important Features of PCP, Handling Task Dependencies	
COMMERCIAL REAL TIME OPERATING SYSTEMS	**(09 Hours)**
Time Services, Unix As Real Time OS, Non-Primitive Kernel, Dynamic Priority Levels, Unix Based Real Time OS, Extension to the Traditional Unix Kernal, Host Target Approach, Preemption Point Approach, RT Linux, Windows CE As Real Time OS, Rea Time POSIX Standard, MC/OS-II	
	(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:	
1. Rajib Mall,"Real Time Systems Theory And Practice",Pearson Education,2007	
2. Wayne Wolf,"Computers as Components: Principles of Embedded Computing System Design",Morgan Kaufman,2001	
3. Liu Jane,"Real-time Systems",PHI,2000	
4. Laplante Phillip A,"Real-Time Systems Design and Analysis: An Engineer's Handbook",2005	
5. Albert M. K. Cheng, "REAL-TIME SYSTEMS Scheduling, Analysis, and Verification",Wiley Interscience,2002	
6. Richard Zurawski, "Embedded Systems Handbook",CRC Taylor Francis,2006	

M. Tech. I (EC) [VLSI] Semester II	L	T	P	C	
EC616:VLSI LAB - II(NEW)	**0**	**0**	**8**	**4**	

1.Simulation Of Analog Sub Circuits •MOS Switch •Current Sink/Source •Current Mirror Circuit •Cascode Amplifier
2. Design And Simulation Of OP-AMPS
3. Design And Simulation Of A/D Converter Circuit
4. Introduction Of RT Linux, MuC/OS-II
5. Task Management, Inter Process Communication Using RT Linux /MuOS- II
6. Parting Real Time OS On Target Hardware And Task Profiling
7. Device Driver

LIST OF SUBJECTS FOR ELECTIVE III , IV & V

M. Tech. I (EC) [CS/VLSI] Semester II	L	T	P	C	
EC602:IMAGE PROCESSING(NEW)	3	0	0	3	
IMAGING SYSTEM					**(04 Hours)**
Camera Model, Image Representation, Human Visual Perception And Color, High-Dynamic-Range Imaging					
IMAGE ANALYSIS					**(08 Hours)**
Spatial Filters, 2D Convolution, Discrete Fourier Transform, DCT, Walsh Transform, KLT And DWT, Concept Of Filtering, Smoothing And Sharpening, Edge Detection					
LOW-LEVEL IMAGE PROCESSING					**(15 Hours)**
Point Operators, Histogram Processing, Image Restoration, Image Enhancement, Image Compression, Morphological Processing, Image Segmentation					
HIGH-LEVEL IMAGE PROCESSING					**(07 Hours)**
Image Representation, Hough Transform For Feature Extraction, Shape Extraction, Boundary Description, Texture Description, Object Recognition And Tracking					
ADVANCED PHOTOGRAPHY					**(08 Hours)**
Introduction To Image Cloning, Warping, Morphing, Imprinting, Watermarking, Super Resolution Image, Image Rendering					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Gonzalez Rafel C. and Woods Richard C.,"Digital Image Processing", Pearson Education, Prentice Hall of India, 2nd Edition,2002					
2. Jain A.K.,"Fundamentals Of Digital Image Processing", Prentice Hall of India, 1st Edition,1989					
3. Jain R., Kasturi R. and Schunck B.G:"Machine Vision", McGraw-Hill 2nd Edition,1995					
4. Pratt W. K,"Digital Image Processing", Prentice Hall, 1st Edition,1989					
5. Rosenfold and Kak A.C,"Digital Image Processing", Vol. 1 and 2, Prentice Hall, 1st Edition,1986					
6. Milan Sonka, Vaclav Hlavac and Roger Boyle,"Image processing, Analysis, And machine Design", Thomson Publishing, India, 2nd Edition,2007					

M. Tech. I (EC) [CS/VLSI] Semester II	L	T	P	C	
EC604:WIRELESS COMMUNICATION(NEW)	3	0	0	3	
GENERAL CONSIDERATIONS					**(12 Hours)**
General Considerations About Radio Waves Over Wireless Channel, Radio Propagation And The Atmosphere, Basic Propagation Mechanisms In General, Radio Propagation Categories For Long Distance Case, Short Distance NLOS Mobile Communication Case, AWGN Model Showing Reflection, Scattering And Diffraction Of Radio Waves For Mobile Systems/Multipath Effect, Large Scale Fading, Small Scale Fading, Delay Spread Effect, ISI, Doppler Shift/Spread, Doppler Power Spectrum, Flat And Frequency Selective Fading					
CHANNEL MODELS					**(05 Hours)**
Channel Models, Equalization Techniques And Diversity Techniques					
SPREAD SPECTRUM MODULATION					**(13 Hours)**
Basic Principle Of Orthogonality, Subcarrier Setting In The Spectrum, FDM Vs Orthogonal FDM, OFDM Block Diagram And Explanation, Pulse Shaping And Windowing In OFDM, Synchronization In OFDM, Pilot Insertion In OFDM Transmission And Channel Estimation, Amplitude Limitations, FFT Points Selection Constraints, CDMA Vs OFDM, Hybrid OFDM, MIMO					
OFDM					**(13 Hours)**
Spread Spectrum Modulation Concepts, ML, Walsh-Hadamard, Gold Sequences, Code Properties, Auto And Cross Correlation, Partial Correlation, DSSS Transmitter, Rake Receiver Block Diagram, PN Signal Characteristics, Spectral Density, Bandwidth And Processing Gain, Interference Rejection, Antijam Characteristics, Energy And Bandwidth Efficiency, Near Far Problem And Power Control, Frequency Hopping Spread Spectrum,Time Hopping, Comparison Of Spread Spectrum Modulation Methods, Hybrid Spread Spectrum System, Chirp Spread Spectrum					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Upena Dalal, "Wireless Communication",Oxford University Press, 1st Edition,2008					
2. Molisch Andreas F.,"Wideband Wireless Digital Communication", Pearson Education, 3rd Indian Reprint,2003					
3. Sharma Sanjay, "Wireless Communications",Katsons Books,2006					
4. Rappaport,T. "Wireless Communications", Pearson Education,5th Indian Reprint,2003					
5. Schulze Henrik and Luders Christian,"Theory And Applications Of OFDM And CDMA - Wideband Wireless Communications",Wiley, 2005					
6. Goldsmith Andrea, "Wireless Communications",Cambridge University Press,2002					
7. Feher Kemilo,"Wireless Digital Communication",PHI, 1995					

M. Tech. I (EC) [CS / VLSI] Semester II	L	T	P	C	
EC618:Reconfigurable Computing(NEW)	3	0	0	3	

INTRODUCTION	**(06 Hours)**
General overview, Goals and motivations, History, state of the art, future trends, Basic concepts and related fields of study, Performance, power, and other metrics, Algorithm analysis and speedup projections, VHDL tutorial, RC Architectures, Device characteristics, Fine-grained architectures, Coarse-grained architectures	
FPGA Physical Design Tools	**(08 Hours)**
Technology mapping, Placement & routing, Register Transfer (RT)/Logic Synthesis, Controller/Datapath synthesis, Logic minimization	
RC Application Design	**(10 Hours)**
Parallelism, Systolic arrays, Pipelining, Optimizations, Bottlenecks, High-level Design,High-level synthesis, High-level languages, Design tools	
System architectures:	**(10 Hours)**
Hybrid architectures, Communication, Hw/sw partitioning, Soft-core microprocessors, System design strategies, System services, Small-scale architectures, HPC architectures, HPEC architectures, System synthesis, Architectural design space explorations.	
Case Studies & Special Topics:	**(08 Hours)**
Signal and image processing, Bioinformatics, Security, Partial Reconfiguration, Numerical Analysis, Performance Analysis/Prediction, Fault Tolerance	
	(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:
1. C. Maxfield,"The Design Warrior's Guide to FPGAs",Newnes,2004
2. M. Gokhale and P. Graham,"Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays",Springer,2005
3. C. Bobda,"Introduction to Reconfigurable Computing: Architectures, Algorithms and Applications",Springer,2007
4. P. Lysaght and W. Rosenstiel (eds.),"New Algorithms, Architectures and Applications for Reconfigurable Computing",Springer,2005
5. D. Pellerin and S. Thibault,"Practical FPGA Programming in C" Prentice-Hall,2005
6. W. Wolf,"FPGA-based System Design",Prentice-Hall, 2004
7. R. Cofer and B. Harding,"Rapid System Prototyping with FPGAs: Accelerating the Design Process",Newnes,2005
8. N. Voros and K. Masselos (eds.),"System-Level Design of Reconfigurable Systems-on-Chip",Springer,2005
9. G. De Micheli,"Synthesis and Optimization of Digital Circuits",McGraw-Hill,1994

M. Tech. I (EC) [CS/VLSI] Semester II	L	T	P	C	
EC632:MICROWAVE INTEGRATED CIRCUITS(NEW)	3	0	0	3	
ACTIVE RF COMPONENTS					**(12 Hours)**
RF Diodes, Bipolar-Junction Transistor, RF FET					
ACTIVE RF COMPONENT MODELING					**(10 Hours)**
Diode Models, Transistor Models, Measurement Of Active Devices, Scattering Parameter Device Characterization					
RF TRANSISTOR AMPLIFIER DESIGNS					**(10 Hours)**
Characteristics Of Amplifiers, Amplifier Power Relations, Stability Considerations, Constant Gain, Noise Figure Circles, Constant VSWR Circles, Broadband, High-Power And Multistage Amplifiers					
OSCILLATORS AND MIXERS					**(10 Hours)**
Basic Oscillator Model, HF Oscillator Configuration, Basic Characteristics Of Mixers					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Ludwig Reinhold and Bretchko Pavel,"RF Circuit Design: Theory And Applications",Pearson Education,3rd Indian Reprint,2004					
2. Massobrio G. and Antognetti P.,"Semiconductor Device Modelling With SPICE",McGraw- Hill,1993					
3. Gonzalez G.,"Microwave Transistor Amplifiers- Analysis And Design",Prentice Hall,1997					
4. Gentili Christian,"Microwave Amplifiers And Oscillators", North Oxford Academic,Revised Edition,1986					
5. Vendelin G., Pavio A and Rhode U. L.,"Microwave Circuit Design Using Linear And Nonlinear Techniques",John Wiley,1990					

M. Tech. I (EC) [CS/VLSI] Semester II	L	T	P	C	
EC634:OPTICAL SIGNAL PROCESSING(NEW)	3	0	0	3	
DIFFRACTION THEORY					**(09 Hours)**
Huygen's Principle, Fraunhofer Diffraction, Fresnel Diffraction, Kirchhoff's Diffraction Theory, Boundary Diffraction Waves, Diffraction Grating					
COHERENCY					**(05 Hours)**
Interference, Visibility, Coherence Function, Spatial Coherence, Temporal Coherence					
FOURIER OPTICS					**(08 Hours)**
Optical Fourier Transform, Linear System, Convolution, Correlation, Fourier Methods In Diffraction Theory, Optical Transfer Function					
INFORMATION OPTICS					**(08 Hours)**
Spatial Frequencies, Abbe's Theory, Spatial Filtering, Phase Contrast, Imaging Enhancement, Optical Filters, Spatial Light Modulator					
APPLICATION OF OPTICAL SIGNAL PROCESSING					**(06 Hours)**
Holography, Information Processing, Optical Pattern Recognition					
ADVANCED OPTICAL SIGNAL PROCESSING					**(06 Hours)**
Digital Optics, Optical Computing, Optical Neural Network					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Goodman J.,"Introduction to Fourier Optics", McGraw Hill, 2nd Edition,2000					
2. Hecht E.,"Optics",Addison Wesley, 4th Edition,2001					
3. Anthony Vanderlugt,"Optical Signal Processing",John Wiley & Sons,2005					
4. Okan K. Ersoy,"Diffraction, Fourier Optics and Imaging",Wiley-Inter Science,2006					
5. W.T. Rhodes,"Fourier Optics and Optical Signal Processing",Wiley-Blackwell,2009					

M. Tech. I (EC) [CS/VLSI] Semester II	L	T	P	C	
EC636:AD-HOC NETWORKS(NEW)	3	0	0	3	
INTRODUCTION					**(04 Hours)**
Introduction To Generations In Wireless Systems, Introduction To Mobile Ad-Hoc Networks (MANETS), Classification Of Mobile Data Networks					
BLUETOOTH					**(08 Hours)**
Bluetooth Network Structure: Piconet & Scatternet, Bluetooth Specifications, Bluetooth Protocol Stack, Bluetooth Media Access Control Consideration, Asynchronous Connectionless And Synchronous Connection Oriented Communication Link, Modified Bluetooth					
WIFI - IEEE802.11 STANDARDS					**(08 Hours)**
Various 802.11 Protocols (a to s), WiFi Architecture, Security Enhancement, QoS Enhancement, Physical & MAC Layer Aspects Of 802.11 a,b,g,e,n; WiFi MAC: Point Coordinate Function, Distributed Coordinate Function, Hybrid Coordinate Function					
WiMAX - IEEE802.16 STANDARDS					**(08 Hours)**
Various 802.16 (a to e) Protocols, WiMAX Air Interface / Physical Layer, WiMAX Architecture, WiMAX Protocol Architecture, WiMAX And WiFi Interworking, WiMAX Mode: TDD And FDD, QoS In WiMAX					
WIRELESS SENSOR NETWORK					**(07 Hours)**
Zigbee IEEE 802.15.4, Mobile Computing Aspects					
UWB					**(02 Hours)**
UWB Air Interface					
IEEE802.20 AND BEYOND					**(02 Hours)**
LONG TERM EVOLUTION					**(03 Hours)**
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Toh C. K.,"Ad-hoc Mobile Wireless Networks",LPE, Pearson Education,2nd Edition,2009					
2. William C.Y. Lee,"Wireless & Cellular Telecommunication", McGraw-Hill,3rd Edition,2005					
3. Upena Dalal,"Wireless Communication",Oxford University,1st Edition,2009					
4. Vijay K. Garg,"Wireless Network Evolution 2G to 3G",Pearson Education,2nd Edition,2004					
5. T. G. Palanievelu, R. Nakkeeran,"Wireless & Mobile Communication",PHI,1st Edition,2009					
6. Schiller Jochen, "Mobile Communications", Addison Wesley, LPE, Pearson Education,4th indian Reprint,2000					

M. Tech. I (EC) [VLSI/CS] Semester II	L	T	P	C	
EC622:LOW POWER VLSI DESIGN(NEW)	3	0	0	3	
INTRODUCTION					**(09 Hours)**
Low Power VLSI, Modeling And Sources Of Power Consumption, Power Estimation At Different Design Levels					
POWER OPTIMIZATION					**(14 Hours)**
Combinational Circuits And Sequential Circuits Voltage Scaling Approaches, Low Energy ComputingUsing Energy Recovery Techniques, Low Power SRAM Architectures					
SOFTWARE DESIGN					**(08 Hours)**
Software Design For Low Power VLSI Design, Computer Aided Design Tools					
CASE STUDIES					**(11 Hours)**
Recent Trends in Low-Power Design for Mobile And Embedded Application					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:>					
1. Roy Kaushik and Prasad Sharat,"Low-Power CMOS VLSI Design",John Wiley & Sons Inc,2000					
2. Chandrakasan Anantha P. and Brodersen Robert W.,"Low Power Digital CMOS Design",Kluwer Academic,1995					
3. Yeap Gary K.,"Practical Low Power Digital VLSI Design", Kluwer Academic,1998					
4. Kiat-Seng Yeo and Kaushi Roy,"Low Voltage Low Power VLSI Subsystems",McGraw- Hill, 1st Edition,2004					
5. Kang S. M.,"CMOS Digital Integrated Circuits",Tata McGraw Hill, 3rd Edition,2003					

M. Tech. I (EC) [VLSI/CS] Semester II	L	T	P	C	
EC624:NANOELECTRONICS(NEW)	3	0	0	3	

INTRODUCTION TO MINIATURIZATION AND NANOSCALE PHYSICS	**(02 Hours)**
Scaling Laws In Mechanics, Electricity, Electromagnetism And Optics The Basics Of Quantum Mechanics: Atomic Orbitals, Electromagnetic Waves, The Quantization Of Energy, Atomic Spectra And Discreetness, The Photoelectric Effect, Wave-Particle Duality, The Uncertainty Principle, Particle In A Well	
INTRODUCTION TO NANOSTRUCTURES AND MEMS	**(15 Hours)**
Nanostructures Like Particles, Wires, Films, Layers And Coatings, Porous Materials, Small Grained Materials And Molecules, Historical Background Of MEMS, Silicon Pressure Sensors, Micro-Electro-Mechanical Systems, Micro-fabrication And Micromachining: Integrated Circuit Processes, Bulk Micromachining, Isotropic Etching And Anisotropic Etching, Wafer Bonding, High Aspect-Ratio Processes	
APPLICATONS AREAS	**(15 Hours)**
a) Nanomechanics: Nanomechanical Memory Elements And Mass Sensors b) Nanoelectronics: Electrons In Solids, Fermi Energy, Density Of States For Solids, Changing The Behavior Of The Solids, Quantum Confinement, Tunneling, Single Electron Phenomenon, Molecular Electronics c) Nanophotonics: Photonic Properties Of Nanomaterials, Near-Field Light, Optical Tweezers, Photonic Crystals	
NANOELECTRONIC DEVICES AND SYSTEMS	**(10 Hours)**
Resonant Tunneling Diode, Quantum Cascade Laser, Single Electron Transistor, Carbon Nanotube Devices, Sensors And Actuators, Physical Microsensors And Actuators, Their Principles, Design Issues And Examples	
	(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:

1. Rogers, Pennathur and Adams,"Nanotechnology: Understanding Small Systems",CRC Press, Tayler And Francis Group,2008

2. Fahrner W. R. (Ed),"Nanotechnology And Nanoelectronics: Materials, Devices, Measurement Techniques",Springer Publications,2005

3. Kumar Vijay,"Nanosilicon",Elsevier Ltd., 1st Edition,2008

4. Kohler and Fritzsche,"Nanotechnology: An Introduction To Nanostructuring Techniques", Wiley-VCH, 1st Edition, 1st Reprint,2004

5. Mahalik N. P.,"Micromanufacturing and Nanotechnology",Springer,2006

M. Tech. I (EC) [VLSI/CS] Semester II	L	T	P	C	
EC626:DSP STRUCTURES FOR VLSI(NEW)	3	0	0	3	
VLSI ARCHITECTURES					**(09 Hours)**
VLSI Architectures for DSP Algorithms, Data Flow Representations, Pipelining And Parallel Processing, Retiming, Unfolding, Register Minimization Techniques, Systolic Architectures					
ALGORITHMS					**(11 Hours)**
Algorithm For Fast Implementation Of Convolution, FIR, IIR And Adaptive Filters, DCT,Analysis Of Finite Word Length Effects					
LOW POWER DESIGN STRATEGIES					**(11 Hours)**
Architecture And Applications Of General Purpose Digital Signal Processors, Architecture and Programming Of TMS 320c55x/ Black Finn High Performance Design Strategies, Case Study Of TMS320C6x/ SHARC					
APPLICATION CASE STUDIES					**(11 Hours)**
Speech Coding, Image Compression, Vitterbi Decoding, Wireless Communication					
					(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:					
1. Wanhammar Lars,"DSP Integrated Circuits", Academic Press,1999					
2. Kuo S. M. and Lee B. H.,"Real-Time Digital Signal Processing: Implementations, Applications & Experiments With The TMS320C55X",Wiley,2001					
3. Parhi K. K.,"VLSI Digital Signal Processing Systems:Design And Implementation",John Wiley 1999					
4. Parhi K. K. and Nishitani T.,"DSP For Multimedia Systems", Marcel Dekker,1999					
5. Higgins Richard J.,"DSP in VLSI", PHI, 1990					

M. Tech. I (EC) [VLSI] Semester II	L	T	P	C	
EC642:VLSI SYSTEM DESIGN(NEW)	3	0	0	3	

INTERCONNECT	**(13 Hours)**
The Wire, Interconnect Parameter, Electrical And Spice Wire Model, RLC Parasitic, Signal Integrity And High Speed Behavior Of Interconnects, Ringing, Cross Talk And Ground Bounce, Layout Strategies At IC And Board Level For Local And Global Signals, Power Supply Decoupling, Advance Interconnect Techniques	
DESIGNING OF SEQUENTIAL LOGIC CIRCUIT	**(13 Hours)**
Static And Dynamic Latches And Registers, Design And Optimization Of Pipelined Stages, Timing Issues In Digital Circuits, Handling Multiple Clock Domains, Synchronous And Asynchronous Design Styles, Interface Between Synchronous And Asynchronous Blocks, Set-Up And Hold Time Violation, Concept Of Meta-Stability	
SYSTEM HARDWARE DECOMPOSITION	**(10 Hours)**
Data Path & Control Path, Register Transfer Level Description, Control Path Decomposition (Interfacing With FSM), Pitfalls of Decomposition, Control Flow And Data Flow Pipelines, Communication Between Subsystems, Control Dead Locks	
MEMORY SUBSYSTEM DESIGN	**(06 Hours)**
Memory Architecture, Shared Memory Data Hazards And Consistency, Mutual Exclusion	
	(Total Contact Time: 42 Hours)
BOOKS RECOMMENDED:	
1. Rabaey Jan M.,"Digital Integrated Circuits (Design Perspective)",Prentice Hall of India,2nd Edition,2003	
2. Smith M. J. S.,"Application Specific Integrated Circuits",Addison Wesley,1999	
3. Dally W. J. and Poulton J. W.,"Digital System Engineering",Cambridge University Press,1998	
4. Hall S. H., Hall G. W. and McCall J. A.,"High Speed Digital System Design",John Wiley And Sons,2000	
5. Bakoglu,"Circuit Interconnect And Packaging For VLSI",Addision-Wesley,1990	
6. Weste N. H. E., David Harris and Banerjee A.,"CMOS VLSI Design", Addison Wesley,3rd Edition,2004	

M. Tech. I (EC) [VLSI] Semester I	L	T	P	C	
EC644:TESTING & VERIFICATION OF VLSI CIRCUITS(NEW)	3	0	0	3	

INTRODUCTION	**(10 Hours)**
Scope Of Testing And Verification In VLSI Design Process, Issues In Test And Verification Of Complex Chips, Embedded Cores And SOCs	

VLSI TESTING FAULT MODELS	**(12 Hours)**
Fundamentals Of Automatic Test Pattern Generation, Design For Testability, Scan Design, Test Interface And Boundary Scan, System Testing and Test For SOC, Delay Fault Testing	

Mu TESTING OF LOGIC AND MEMORIES	**(10 Hours)**
Test Automation, Design Verification Techniques Based On Simulation, Analytical And Formal Approaches	

VERIFICATION	**(10 Hours)**
Functional Verification, Timing Verification, Formal Verification, Basics of Equivalence Checking And Model Checking, Hardware Emulation	

	(Total Contact Time: 42 Hours)

BOOKS RECOMMENDED:
1. Bushnell M. and Agrawal V. D.,"Essentials Of Electronic Testing For Digital, Memory And Mixed-Signal VLSI Circuits",Kluwer Academic Publishers,2000
2. Abramovici M., Breuer M. A. and Friedman A. D.,"Digital Systems Testing And Testable Design",IEEE Press,1990
3. Kropf T., "Introduction To Formal Hardware Verification", Springer Verlag,2000
4. Rashinkar P., Paterson and Singh L.,"System-On-A-Chip Verification-Methodology And Techniques",Kluwer Academic Publishers,2001
5. Neil H. E. Weste and David Harris,"Principles Of CMOS VLSI Design",Addison Wesley, 3rd Edition,2004

Appendix 1

Sr. No.	Course Name	Code	Teaching Scheme			Credit	Examination Scheme			Total
			L	T	P		Theory	Tutorial	Practical	
1	Dissertation Preliminaries	EC 805	0	0	16	8	0	0	400	400
2	Seminar	EC 807	0	0	4	2	0	0	100	100
Total			0	0	20	10	0	0	500	500
Total Contact Hours per week: 20										

M.Tech. II(EC), III Semester (VLSI & Embedded Systems)

Appendix 1

M.Tech. II(EC), IV Semester (VLSI & Embedded Systems)										
Sr. No.	Course Name	Code	Teaching Scheme			Credit	Examination Scheme			Total
			L	T	P		Theory	Tutorial	Practical	
1	Dissertation	EC 804	0	0	24	12	0	0	400	400
Total			0	0	24	12	0	0	400	400
Total Contact Hours per week: 24										