

Bhagalpur College of Engineering, Bhagalpur

Department of Electronics and Communication Engineering

Syllabus for M.Tech. in Microelectronics and VLSI Technology

M.Tech. - ECE (Microelectronics & VLSI Designs) Common Syllabus

Semester-1

Paper Type	Paper Code	Paper Name	Instruction Hours			Credit Points
			L	T	P	
Basic Core	MVLSI-101	Advanced Engg Maths	3	1	0	4
Basic Core	MVLSI-102	Advanced semiconductor physics and Devices	4	0	0	4
Basic Core	MVLSI-103	VLSI Device & Modelling	4	0	0	4
Programme Elective	MVLSI-104	Elective-I 1. Reliability Engineering 2. AI & Neural Networks 3. Digital Image processing 4. Embedded System Fundamentals	4	0	0	4
Basic Core	MVLSI-105	Microelectronic Technology & IC Fabrication	4	0	0	4
		Total of Theory	19	1		20
Basic Core Lab	MVLSI-111	CAD Tools for VLSI Design Lab-I			2	2
Basic Core Lab	MVLSI-112	Semiconductor physics and Devices Lab			2	2
		Total of Practical			4	4
Basic Core	MVLSI-121	Seminar			1	1
Basic Core		Total	19		25	25

Semester-II

Paper Type	Paper Code	Paper Name	Instruction Hours			Credit Points
			L	T	P	
Basic Core	MVLSI-201	Advanced Signal Processing & Its Applications	3	1	0	4
Basic Core	MVLSI-202	Analog VLSI Circuits	4	0	0	4

Basic Core	MVLSI-203	Digital Logic Design	4	0	0	4
Basic Core	MVLSI-204	Digital CMOS IC Design	4	0	0	4
Programme Elective	MVLSI-205	Elective-II 1. RF Circuits & Systems 2. Sensors and Transducers 3. Introduction to opto electronics devices and circuits 4. Hetero Junction Devices	4	0	0	4
		Total of Theory	19	1		20
Basic Core Lab	MVLSI-211	CAD Tools for VLSI Design Lab-II			2	2
Basic Core Lab	MVLSI-212	Digital Logic Design using Verilog Lab			2	2
		Total of Practical			4	4
Basic Core	MVLSI-122	Term paper leading to Thesis			1	1
Basic Core		Total	19		25	25

Semester-III

Paper Type	Paper Code	Paper Name	Instruction Hours			Credit Points
			L	T	P	
Basic Core	MVLSI-301	Teaching & Research Methodologies	4	0	0	4
Minor Project	MVLSI-311	Project-1			16	16
		Total	4		16	20

Semester-IV

Paper Type	Paper Code	Paper Name	Instruction Hours			Credit Points
			L	T	P	
Major Project	MVLSI-411	Project-2			28	28

MVLSI101 Advanced Engineering Mathematics		
S. No	Contents	Contact Hours
1	Complex Variables: Complex Variables: Elements of set theory, Set notations, Applications of set theory, Open & Closed Sets. Review of Complex variables, Conformal mapping and transformations, Functions of complex variables, Integration with respect to complex argument, Residues and basic theorems on residues.	8
2	Numerical Analysis: Introduction, Interpolation formulae, Difference equations, Roots of equations, Solutions of simultaneous linear and non-linear equations, Solution techniques for ODE and PDE, Introduction to stability, Matrix eigen value and eigen vector problems.	8
3	Optimization Technique: Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Elements of calculus of variation, Constrained Optimization, Lagrange multipliers, Gradient method, Dynamic programming.	8
4	Probability and Statistics: Definition and postulates of probability, Field of probability, Mutually exclusive events, Bayes' Theorem, Independence, Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.	8
5	Fourier series and Transform: Fourier series, integrals and transforms and their properties. One dimensional Fourier transform, Convolution theorem, Parseval's formula, Introduction to 2-dimensional Fourier transform.	8
Total		40
Sl. No.	Name of Authors / Books /Publishers	
1.	1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill	
2	2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.	
3	3. Halmos, T. R.-Naïve Set Theory, Van Nostrand	
4	4. I.N. Sneddon, Fourier Transform	
5.	5. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press	
Reference Books:		
1. Sen, M. K. and Malik, D. F.-Fundamental of Abstract Algebra, Mc. Graw Hill		
2. Khanna, V. K. and Ghamdri, S. K.- Course of Abstract Algebra, Vikash Pub.		
3. Halmos, T. R.-Naïve Set Theory, Van Nostrand		
4. Scarborough, J. B.-Numerical Mathematical Analysis, Oxford University Press		
5. Cone, S. D.-Elementary Numerical Analysis, Mc. Graw Hill.		
6. Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency		

7. Kapoor, V. K and Gupta, S.C.-Fundamental of Mathematical Statistics, Sultan Chand and Sons.
8. Uspensky, J. V.-Introduction to Mathematical Probability, Tata Mc. Graw Hill
9. Dreyfus, S. E.-The Art and Theory of Dynamic Programming –Theory and Applications, Academic Press.
10. Rao, S. S.-Optimisation Theory and Application, Wiley Eastern Ltd., New Delhi.

MVLSI-102: Advanced Semiconductor Physics		
S. No	Contents	Contact Hours
1	Physics and properties of Semiconductors: - Crystal Structure of Solids; Introduction to Quantum Mechanics; Introduction to the Quantum theory of Solids: Bloch Theorem, Allowed and Forbidden Energy bands (Kronig-Penny model, k-space diagram), Statistics and Fermi-Dirac probability function; Semiconductor in Equilibrium, Carrier Transport Phenomena, Non-equilibrium Excess carriers in semiconductors.	10
2	Device Building Blocks : P-N junctions under equilibrium, Forward bias and Reverse bias, Diode current equation; Diode Capacitances; Junction breakdown; Generation-Recombination currents; Schottky Barrier diode; Metal-Semiconductor Ohmic contacts; Metal-Insulator-Semiconductor capacitors (Ideal and Non-ideal), Tunnel Diode.	9
3	Bipolar Junction Transistors: - Introductory operational considerations, Performance parameters, Ideal transistor analysis; Non-ideal effects; Equivalent Circuit models; Other Bipolar Transistor structures.	8
4	Field Effect Transistors: - JFET; MOSFET (Non-ideal effects, MOSFET scaling, V_T modifications; MESFET; HEMT; Charge Coupled Devices.	9
5	Other semiconductor devices: - Optical absorption, Photoluminescence and Electroluminescence; Photodetectors and Solar cells; LEDs and LASERs.	4
Total		40
Sl. No.	Name of Authors / Books /Publishers	Year of Publication
1	“Physics of Semiconductor Devices” S. M. Sze, 2 nd edition.	1981
2	“Semiconductor Device Fundamentals”, by R. F. Pierret, Addison-Wesley publishing company.	1996
3	“Semiconductor Physics and Devices :Basic Principles”, by Donald A. Neamen, 3 rd Edition	2003
4	“Semiconductor Physics & Devices”, by S S Islam, Oxford University Press.	2006
5	“Device Electronics for Integrated Circuits”, R.S. Muller and T.I. Kamins, Wiley.	1986

MVLSI-103: VLSI DEVICE AND MODELLING		
S. No	Contents	Contact Hours
1	<p>BASIC OF DEVICE PHYSICS</p> <p>Two Terminal MOS Structure: Flat - band voltage, Potential balance & charge balance, Effect of Gate-substrate voltage on surface condition: Accumulation, Depletion and Inversion, Small signal capacitance.</p> <p>Three Terminal MOS Structure: Contacting the inversion layer, Body effect, Regions of inversion, Pinch - off voltage.</p>	8
2	<p>Four Terminal MOS Transistor: Transistor regions of operation, general charge sheet models, regions of inversion in terms of terminal voltage: strong inversion, weak inversion, moderate inversion, interpolation models, effective mobility, temperature effects, breakdown, p-channel MOSFET, enhancement and depletion type, model parameter values, model accuracy etc.; Small dimension effects: channel length modulation, barrier lowering, two dimensional charge sharing and threshold voltage, punch-through, carrier velocity saturation, hot carrier effects, scaling, effects of surface and drain series resistance, effects due to thin oxides and high doping, Sub-threshold regions.</p>	8
3	<p>Large-Signal modeling of the MOS transistor in transient operation: - Quasi static operation : Terminal currents, Evaluation of Intrinsic charges, Limitations; non-Quasi-static modelling; Extrinsic parasitic.</p>	9
4	<p>Small-Signal modeling for low and medium frequencies : - Low-frequency small-signal model for the intrinsic part, Medium-frequency small-signal model for the intrinsic part, Including the extrinsic part, Noise.</p>	9
5	<p>Small-Signal modeling for high frequency operation :- Complete Quasi-static model for the intrinsic part; y-parameters, non-quasi-static models.</p>	8
Total		42
Sl. No.	Name of Authors / Books / Publishers	Year of Publication
1.	“Fundamentals of Modern VLSI Devices” by Yuan Taur & Tak H. Ning (Cambridge)	
2	“The MOS Transistor”, by Yannis Tsividis, Oxford University Press, 2 nd edition.	

MVLSI-104 (a): Reliability Engineering		
S. No	Contents	Contact Hours
1	Basic Probability Theory :- Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples..	10
2	Network Modeling and Reliability Evaluation :- Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cutset based approach – complete event tree and reduced event tree methods - Examples.	7
3	Time Dependent Probability :- Basic concepts – Reliability functions $f(t)$, $F(t)$, $R(t)$, $h(t)$ – Relationship between these functions – Baths tubs curve – Exponential failure density and distribution functions - Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel, Series-Parallel systems - Partially redundant systems - Evaluation of reliability measure – MTTF for series and parallel systems – Examples.	8
4	Discrete Markov Chains & Continuous Markov Processes :- Basic concepts – Stochastic transitional Probability matrix – time dependent probability evaluation – Limiting State Probability evaluation – Absorbing states – Markov Processes-Modelling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach - Examples.	9
5	Multi Component & Approximate System Reliability Evaluation :- Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model - Series systems, Parallel systems, Basic reliability indices – Cutset approach – Examples.	6
Total		40
Recommended Books:		
<ol style="list-style-type: none"> 1. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015. Neural Networks & Fuzzy Logic - by Bart Kosko 2. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2007. 		

3. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.
4. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.
5. Probability concepts in Electric Power system – G.J.Anders- 1 st edition –1990 – John wiley & sons.

MVLSI-104 (b): AI & Neural Networks		
S. No	Contents	Contact Hours
1	Overview of AI - Introduction, hierarchical perspective and foundations. Problems of AI, AI techniques, Tic-Tac-Toe problem. Basic problem solving methods: Production systems-State space search-Control strategies- Heauristic search techniques-Forward and backward reasoning-Hill climbing techniques-Best search.	10
2	Knowledge representation: Predicate logic- Resolution Question answering-Nonmonotonic reasoning-Statistical and probabilistic reasoning-Semantic nets-Frames -Scripts.	7
3	Neural Network: Biological neurons and brain, mathematical models of neuron, basic structure of a neural network, Learning rules, ANN training, back propagation algorithm, Hopfield nets and application of Neural Network.	8
4	Introduction to expert system-Design of an expert system-Fuzzy logic and neural network in control system, modelling estimation and design methodologies and real time application of Intelligent control system like TRMS, Robot and Magnetic levitation system.	9
5	AI languages: Important characteristics of AI languages-PROLOG. Application of AI & neural networks in VLSI and embedded systems.	6
Total		40
Recommended Books:		
<ol style="list-style-type: none"> 6. Neural Networks - by Simon Haykin 7. Neural Networks & Fuzzy Logic - by Bart Kosko 8. Neural computing theory & practice - by P.D. wasserman (ANZA PUB) 9. Introduction to artificial neural systems - by J.M. Zurada.(Jaico Pub) 		

MVLSI-104 (c): Digital Image processing		
S. No	Contents	Contact Hours
1	Digital Image Fundamentals: Definition, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of visual perception – Image sampling and Quantization, Basic relationship between pixels – Basic geometric transformations.	7
2	Introduction to Fourier Transform and DFT – Properties of 2D Fourier Transform – FFT – Separable Image Transforms -Walsh – Hadamard – Discrete Cosine Transform, Haar.	5
3	Image Enhancement Techniques: Spatial Domain methods: Basic grey level transformation, Histogram Equalization, Image Subtraction, Image averaging, Spatial filtering: Smoothing, sharpening filters – Laplacian filters, Frequency domain filters: Smoothing – Sharpening filters, Homomorphic filtering.	9
4	Image Restoration: Model of Image Degradation/restoration process, Noise models, Inverse filtering, Least mean square filtering, Blind image restoration, Singular value decomposition.	8
5	Image Compression and Segmentation: Lossless compression: Variable length coding, LZW coding, Bit plane coding, Predictive coding-DPCM, Lossy Compression: Transform coding, Wavelet coding, Basics of Image compression standards: JPEG, MPEG, Edge detection, Thresholding, Region Based segmentation.	11
Total		40
Recommended Books:		
<ol style="list-style-type: none"> 1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing”, Pearson Education, 2002. 2. G. A. Baxes, “Digital Image Processing” John Wiley, 1994 (Int. Ed.). 3. R.J. Schalkoff, “Digital Image Processing and Computer Vision” John Wiley, 1989. 4. Sid Ahmed, “Image Processing” McGraw -Hill, 1994. 5. William K Pratt, “Digital Image Processing” John Willey, 2001. 6. MillmanSonka, Vaclav hlavac, Roger Boyle, “Image Processing Analysis and Machine Vision”Broos/colic, Thompson Learning, 1999. 7. A. K. Jain, “Fundamentals of Digital Image processing” PHI, 2002. 8. Chanda Dutta Magundar, ”Digital Image Processing and Applications” Prentice Hall of India, 2000. 		

MVLSI-104 (d): Embedded System Fundamentals		
S. No	Contents	Contact Hours
1	Introduction to embedded systems: Concept, Difference between embedded computer systems and general purpose computer Systems, Classification, Characteristics, Applications	6
2	Overview of Embedded Processors: Classification: GPP, ASIP, SPP, ASSP, MULTI-CORE, SOFT-CORE - Examples	7
3	Overview of Embedded Memories & Interfacing: SRAM, DRAM, EEPROM, FLASH, DUAL-PORT, CACHE, INTERLEAVED MEMORIES	8
4	Overview of Embedded Networking & Standards: RS232, RS485, SPI, USB, ISA, PCI, I2C, CAN, LIN IrDA, Bluetooth, Zigbee. Overview of Embedded Sensors and Transducers: Pressure, Temperature, Acceleration, Image, Rain, Proximity, Hall-effect, Artificial eyes	12
5	Overview of I/P-O/P devices & Interfacing: Keypad, TWS, JoyStick, SSL, LCD, VGA	7
	Total	40
	Recommended Books:	
Sl. No.	Name of Authors / Books /Publishers	Year of Publication
1	Frankvahid/Tony Givargis, Embedded System Design- A unified Hardware/software Introduction".	
2	David E Simon, An embedded software primer ", Pearson education Asia, 2001.	2001
3	J.W. Valvano, Embedded Microcomputer System: Real Time Interfacing"	
4	Jack Ganssle, The Art of Designing Embedded Systems", Newnes, 1999.	1999

MVLSI-105: Microelectronic Technology & IC Fabrication		
S. No	Contents	Contact Hours
1	Introduction to MOS technology : Introduction to IC technology, MOS & related VLSI technology, Basic MOS transistors (Enhancement mode and depletion mode), NMOS process, CMOS process (P – Well, N – Well, Twin – tub processes), Bi CMOS process flow, aspects of CMOS & Bi CMOS devices.	6
2	Crystal growth and doping : Starting materials, Czochralski technique, Gradient freeze technique, Considerations for proper crystal growth (role of point defects, thermal gradients, turbulences, pull and spin rate, crystal orientation, crystal hardening techniques), Doping (rapid stirring conditions, partial stirring conditions, radial doping variations), Zone processes (Zone refining, Zone leveling, neutron transmutation doping)	4
3	Diffusion - Diffusion in a concentration gradient, Diffusion equation, Impurity behavior in Silicon, diffusion systems for Silicon, redistribution during oxide growth, diffusion during oxide growth, cooperative diffusion, evaluation techniques for diffused layers in Silicon.	4
4	Epitaxy : Nucleation and growth, doping, dislocation, thermally induced strain, Molecular Beam epitaxy, Vapor phase epitaxy for Silicon, Liquid phase epitaxy	4
5	Ion-Implantation : Penetration range (nuclear and electronic stopping, Transverse effects), Implantation damage, annealing, Ion – Implantation systems, process consideration, high energy and high current implants. .	4
6	Native Films : Thermal Oxidation of silicon (kinetics of oxide growth, oxidation systems, oxidation induced stacking faults, properties of thermal oxides), Thermal nitridation of Silicon, Plasma processes.	4
7	Deposited Films : Films deposition methods (vacuum evaporation, sputter deposition, Chemical vapor Deposition), Film characteristics (step coverage, grown habit, mechanical stress, electromigration)	4
8	Etching and Cleaning : wet chemical etching in silicon based processes, Dry physical etching, Dry chemical etching, Reactive Ion etching, Etch induced damage, Cleaning (wet and dry)	4
9	Lithography : Photoreactive materials, pattern generation and mask making, pattern transfer- optical printing, advanced techniques (short wavelength, multilayer resist, phase shifting masks, Electron beam techniques, Xray printing), Mask defects, Pattern transfer defects	4
10	Process integration : Isolation, (P-N junction, Mesa, Oxide), self alignment, local oxidation, lanarization, metallization, gettering, Process flow for CMOS-	4
Total		42

Recommended Books:

Text Books : 1. Basic VLSI Design by Pucknell and Eshraghian
2. VLSI Fabrication Principles by Sorab Gandhi

Reference Books :

1. The science and engineering of Microelectronic Fabrication by Stephen Campbell
2. VLSI Design by Sujata Pandey and Manoj Pandey
3. CMOS VLSI design by Wolfe

MVLSI-201: Advanced Signal Processing & Its Applications		
S. No	Contents	Contact Hours
1	Introduction: Review of basic digital signal processing fundamentals, Parametric methods for power spectrum estimation-Relationship between the auto correlation and the model parameters – The Yule – Walker method for the AR Model Parameters – The Burg Method for the AR Model parameters – unconstrained least-squares method for the AR Model parameters – sequential estimation methods for the AR Model parameters – selection of AR Model order.	9
2	Adaptive Filters: Adaptive signal processing-FIR adaptive filters – steepest descent adaptive filter – LMS algorithm – convergence of LMS algorithms – Application: noise cancellation – channel equalization – adaptive recursive filters – recursive least squares.	7
3	Multirate Signal Processing: Multirate signal processing- Decimation by a factor D – Interpolation by a factor I – Filter Design and implementation for sampling rate conversion: Direct form FIR filter structures – Polyphase filter structure.	7
4	Speech Signal Processing: Speech signal processing-Digital models for speech signal : Mechanism of speech production – model for vocal tract, radiation and excitation – complete model – time domain processing of speech signal:- Pitch period estimation – using autocorrelation function – Linear predictive Coding: Basic Principles – autocorrelation method – Durbin recursive solution.	8
5	Wavelet Transforms and their Application: Wavelet Transform-Fourier Transform : Its power and Limitations – Short Time Fourier Transform – The Gabor Transform - Discrete Time Fourier Transform and filter banks – Continuous Wavelet Transform – Wavelet Transform Ideal Case – Perfect Reconstruction Filter Banks and wavelets – Recursive multi-resolution decomposition–Haar Wavelet – Daubechies Wavelet.	9
Total		40
Sl. No.	Name of Authors / Books /Publishers	Year of Publication
1.	John G.Proakis, DimitrisG.Manobakis, “Digital Signal Processing, Principles, Algorithms and Applications” 3rd edition, PHI, 2000.	2000
2	Monson H.Hayes, “Statistical Digital Signal Processing and Modelling” Wiley, 2002.	2002
3	Emmanuel C. Ifeachor and Barrie W. Jervis, “Digital Signal Processing: A Practical Approach” Pearson Education, 2008.	2008
4	Robert J. Schilling and Sandra L. Harris, “Fundamentals of Digital Signal Processing” Cengage Learning, 2005.	2005

MVLSI-202: Analog VLSI Circuits		
S. No	Contents	Contact Hours
1	Introduction: Analog MOS circuits, single stage amplifiers, differential amplifiers, passive and active current mirrors, frequency and transient responses, noise, feedback, operational amplifiers, stability and frequency compensation, analog switches, switched-capacitor circuits, oscillators.	11
2	Filters & A/D Converters: Sampled Data Analog Filters, Over Sampled A/D Converters and Analog Integrated Sensors: First-order and Second SC Circuits-Bilinear Transformation – Cascade Design-Switched-Capacitor Ladder Filter-Synthesis of Switched-Current Filter – Nyquist rate A/D Converters-Modulators for Over sampled A/D Conversion	11
3	Operational Amplifier: Differential and Common mode circuits, Op Amp CMRR requirements, Need for single and multistage amplifiers, Effect of loading in differential stage. Performance Analysis: dc gain, frequency response, noise, mismatch, slew rate of cascade and two stage OP Amps, fully Differential Op Amps-common-mode feedback, loop stability	10
4	Phase Locked Loops: Problem of lock acquisition, phase Detector. Basic PLL and its dynamics, Charge-pump PLL, Non-ideal effects in PLL: PFD/CL non idealities, Jitter, Delay Locked Loop, Amplifications	8
Total		40
Recommended Books 1. Neil H. E. Weste & Kamran Eshraghian, “Principles of CMOS VLSI Design” 2 nd edition, Pearson education Asia, 2000. 2. Wayne Wolf, “Modern VLSI Design” Pearson Education, 4 th Indian Reprint 2005. R.S. Muller and T.I. Kamins, “Device Electronics for Integrated Circuits” Wiley, 1986. 3. DA. and Eshraghian K, “Basic VLSI design-systems & circuits”, PHI, 1988. 4. B Razavi, “Design of Analog CMOS Integrated Circuits”, McGraw Hill, 2000		

MVLSI-203: Digital Logic Design		
S. No	Contents	Contact Hours
1	Revision of basic Digital systems: Combinational Circuits, Sequential Circuits, Logic families. Synchronous FSM and asynchronous design, Metastability, Clock distribution and issues, basic building blocks like PWM module, pre-fetch unit, programmable counter, FIFO, Booth's multiplier, ALU, Barrel shifter etc.	9
2	Verilog/VHDL Comparisons and Guidelines, Verilog: HDL fundamentals, simulation, and test-bench design, Examples of Verilog codes for combinational and sequential logic, Verilog AMS System	7

3	Verilog and Verification: Verification guidelines, Data types, procedural statements and routines, connecting the test bench and design, Assertions, Basic OOP concepts, Randomization,	5
4	Introduction to basic scripting language: Perl, Tcl/Tk. Current challenges in physical design: Roots of challenges, Delays: Wire load models Generic PD flow, Challenges in PD flow at different steps, SI Challenge - Noise & Crosstalk, IR Drop, Process effects: Process Antenna Effect & Electromigration.	7
5	Programmable Logic Devices: Introduction, Evolution: PROM, PLA, PAL, Architecture of PAL's, Applications, Programming PLD's, FPGA with technology: Antifuse, SRAM, EPROM, MUX, FPGA structures, and ASIC Design Flows, Programmable Interconnections, Coarse grained reconfigurable devices.	7
6	IP and Prototyping: IP in various forms: RTL Source code, Encrypted Source code, Soft IP, Netlist, Physical IP, and Use of external hard IP during prototyping, Case studies, and Speed issues. Testing of logic circuits: Fault models, BIST, JTAG interface.	7
	Total	40

Reference Books:

- Douglas Smith, "HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog", Doone publications 1998.
- Samir Palnitkar, "Verilog HDL, A guide to Digital Design and Synthesis", Prentice Hall.
- Doug Amos, Austin Lesea, Rene Richter, "FPGA based Prototyping Methodology Manual", Synopsys Press.
- Christophe Bobda, "Introduction to Reconfigurable Computing, Architectures, Algorithms", Springer Netherlands.
- Janick Bergeron, "Writing Testbenches: Functional Verification of HDL Model", Second Edition, Springer 2003.
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MVLSI-204: DIGITAL CMOS IC DESIGN		
S. No	Contents	Contact Hours
1	MOS transistor theory and modeling :- The Metal Oxide Semiconductor (MOS) Structure, MOS System under External Bias, Structure and Operation of MOS Transistor (MOSFET), Current-Voltage Characteristics, Scaling and Small-Geometry Effects, MOSFET modelling, Small-signal model. Fabrication and Layout of CMOS ICs :-Fabrication Process Flow: Basic Steps, CMOS nWell Process, Layout Design Rules, Full-Custom Mask Layout Design	10
2	MOS INVERTERS Static characteristics :- Resistive-Load Inverter, Inverters with n-Type MOSFET Load, CMOS Inverter Switching characteristics and interconnect effects :- Delay-Time definitions, Calculation of Delay times, Inverter Design with Delay Constraints, Estimation of Interconnect Parasitics, Calculation of Interconnect Delay, Switching Power Dissipation of CMOS Inverters	8
3	Combinational MOS logic circuits :-MOS Logic Circuits with Depletion nMOS Loads, CMOS Logic Circuits, Complex Logic Circuits, CMOS Transmission Gates (Pass Gates) Sequential MOS logic circuits :-Behavior of Bistable Elements, The SR Latch Circuit, Clocked Latch and Flip-Flop Circuits, CMOS D-Latch and Edge-Triggered Flip-Flop	10
4	Dynamic logic circuits :-Basic Principles of Pass Transistor Circuits, Voltage Bootstrapping, Synchronous Dynamic Circuit Techniques, High-Performance Dynamic CMOS Circuits CMOS Differential Logic families :- Dual Rail Logic, Cascode Voltage Switch Logic, Complementary Pass-Transistor Logic, Dual Pass-Transistor Logic.	8
5	Semiconductor Memories :-Read-Only Memory (ROM) Circuits, Static Read-Write Memory (SRAM) Circuits, Dynamic Read-Write Memory (DRAM) Circuits, Low power memory design.	5
Total		41
Sl. No.	Name of Authors / Books /Publishers	Year of Publication
1.	“CMOS: Digital Integrated Circuits”, by Sung-Mo Kang and Yusuf Leblibici, 3 rd edition, McGraw-Hill Higher Education.	2003
2	“CMOS Logic Circuit Design”, by John P. Uyemura, Kluwer Academic Publishers	2001
3	“Digital Integrated Circuits - A Design Perspective”, by Jan M. Rabaey, 2 nd Edition	
4	“CMOS VLSI Design: A Circuits and Systems Perspective”, by Neil Weste and David Harris 4 th Edition	
5	“CMOS ; Circuit Design, Layout and Simulation”, by R. Jacob Baker, 3 rd edition, IEEE press.	2010

MVLSI-205 (a): RF Circuits & Systems		
S. No	Contents	Contact Hours
1	Characterization of materials used for different RF electronic devices. Heterostructure-overview. High frequency transistors- BJT,field effect transistors . Basics of resonant tunneling, RT devices.	10
2	Introduction to RF/Microwave Concepts .Active and passive RF components, circuit representations of two port RF/MW networks scattering and T parameters, smith chart.	7
3	Basic Considerations in Active Networks- Stability and noise considerations, Gain Considerations in Amplifiers. Active Networks - Linear and Nonlinear Design, RF/MW Amplifier. RF/MW Oscillators- Basic topologies, VCO, Quadrature and single sideband generators.	8
4	Radio frequency Synthesizers- PLLS, Various RF synthesizer architectures and frequency dividers. Overview of RF Filter design, design of rectifier, detector, mixer, RF/MW control circuit. Small RF/MW antenna and Array.	10
5	RF/MW Integrated circuits - design and applications	5
Total		40

MVLSI-205 (b): Sensor and Transducer		
S. No	Contents	Contact Hours
1	Mechanical and Electromechanical sensor: Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. Inductive sensor: common types Reluctance change type, Mutual inductance change type, transformer action type, Magnetostrictive type, brief discussion with respect to material, construction and input output variable, Ferromagnetic plunger type, short analysis. LVDT: Construction, material, output input relationship, I/O curve, discussion. Proximity sensor	10
2	Capacitive sensors: Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics. Piezoelectric element: piezoelectric effect, charge and voltage coefficient, crystal model, materials, natural & synthetic type, their comparison, force & stress sensing, ultrasonic sensors.	7
3	Thermal sensors: Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type, Thermister material, shape, ranges and accuracy specification. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type. Radiation sensors: types, characteristics and comparison. Pyroelectric type	8
4	Magnetic sensors: Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR, Photovoltaic cells, photodiodes, photo emissive cell types, materials, construction, response. Geiger counters, Scintillation detectors, Introduction to smart sensors	10
Total		40
Recommended Books:		
<ol style="list-style-type: none"> 1. Sensor & transducers, D. Patranabis, 2nd edition, PHI 2. Instrument transducers, H.K.P. Neubert, Oxford University press. 3. Measurement systems: application & design, E. A. Doebelin, McGraw Hill 		

MVLSI-205 (c): Introduction to Opto-electronics Devices and Circuit		
S. No	Contents	Contact Hours
1	Introduction: Generic Optical Systems and Fundamental Building Blocks;	5
2	Basics of Semi-conductor Optoelectronics: Elemental and Compound Semiconductors;	5
3	Electronic Properties and Optical Processes in Semiconductors;	5
4	P-N Junction Theory, LEDs and Photodetectors;	5
5	Heterostructures, Confinement of Electron Waves, Optical Waveguides and Guided Modes;	5
6	Semiconductor Optical Amplifiers and Fabry-Perot Lasers;	2
7	Coupled Mode Theory, DBR and DFB Lasers; Silicon Photonics: Integrated Optical Passive and Active Components; Tunable Filters, Delay-Lines and Switching Circuits in SOI Platform;	8
8	CMOS Technology: Electrical vs. Optical Interconnects	5
	Total	40
Reference Books:		
1.Semiconductor Optoelectronic Devices Author(s): Pallab Bhattacharya (Pearson Education Inc.)		
2. Photonics – Optical Electronics in Modern Communications Author(s): A. Yariv and P. Yeh (Oxford University Press)		
3. Silicon Photonics – Fundamentals and Devices Author(s): M. Jamal Deen and P.K. Basu (John Wiley & Sons Ltd.)		

MVLSI-301: Hetero Junction Devices		
S. No	Contents	Contact Hours
1	Materials for high speed devices and circuits:- Merits of III –V binary and ternary compound semiconductors (GaAs, InP, InGaAs, AlGaAs ETC.), silicon-germanium alloys and silicon carbide for high speed devices, as compared to silicon based devices. Brief outline of the crystal structure, dopants and electrical properties such as carrier mobility, velocity versus electric field characteristics of these materials. Material and device process technique with these III-V and IV – IV semiconductors.	8
2	Metal semiconductor Field Effect Transistors (MESFETs):- Pinch off voltage and threshold voltage of MESFETs. D.C. characteristics and analysis of drain current. Velocity overshoot effects and the related advantages of GaAs, InP and GaN based devices for high speed operation. Sub threshold characteristics, short channel effects and the performance of scaled down devices.	8
3	High Electron Mobility Transistors (HEMT) :- Hetero-junction devices. The generic Modulation Doped FET(MODFET) structure for high electron mobility realization. Principle of operation and the unique features of HEMT. InGaAs/InP HEMT structures.	8
4	Hetero junction Bipolar transistors (HBTs):- Principle of operation and the benefits of hetero junction BJT for high speed applications. GaAs and InP based HBT device structure and the surface passivation for stable high gain high frequency performance. SiGe HBTs and the concept of strained layer devices.	8
5	High speed Circuits:- GaAs Digital Integrated Circuits for high speed operation- Direct Coupled Field Effect Transistor Logic (DCFL), Schottky Diode FET Logic (SDFL), Buffered FET Logic(BFL). GaAs FET Amplifiers. Monolithic Microwave Integrated Circuits (MMICs) (4 hours) 9. High Frequency resonant – tunneling devices. Resonant-tunneling hot electron transistors and circuits.	8
	Total	40
<p>Text Books:</p> <ol style="list-style-type: none"> 1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition. 2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005 3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition 4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013. 		

MVLSI-301:Research Process and Methodology		
S. No	Contents	Contact Hours
1	Introduction to Research and Problem Definition: Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem	8
2	Research Design: Research design, Methods of research design, research process and steps involved, Literature Survey.	8
3	Data Collection: Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research.	8
4	Data Analysis and interpretation: Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results	8
5	Technical Writing and reporting of research Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research Journals, Indexing and citation of Journals, Intellectual property, Plagiarism	8
	Total	40
Text Books:		
1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.		
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005		
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition		
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013.		