University of Engineering & Management Jaipur

Syllabus to be implemented from the Academic Year 2023-24

M.Tech (Microelectronics & VLSI)

First Year, Semester-I

A. THEORY							
Sl.No.	**Subject Code**	**Theory**	**Contact Hours/Week**				Credit
			L	**T**	**P**	**Total**	
1	MVLSI101	VLSI Devices and Modeling	3	1	0	4	4
2	MVLSI102	Digital IC Design	3	1	0	4	4
3	MVLSI103	Program Elective-1 **A- Processor Architecture** B- Parallel Architecture and Processing C- System on Chip (SOC) Design	3	1	0	4	4
4	MVLSI104	Program Elective-2 **D- Fabrication Technology** E- Physical design Automation	3	1	0	4	4
5	MVLSI105	Program Elective-3 **F- Digital Image Processing** G- CAD of Digital Systems	3	1	0	4	4
TOTAL OF THEORY							20
B. PRACTICAL							
6	MVLSI191	Design and Simulation Lab	0	0	3	3	2
7	MVLSI192	Processor Architecture Lab	0	0	3	3	2
8	MVLSI181	Seminar – Based on Literature Survey	0	0	3	3	1
TOTAL OF PRACTICAL							5
TOTAL OF SEMESTER							25

University of Engineering & Management Jaipur

First Semester Syllabus

TITLE OF COURSE: ADVANCED ENGINEERING MATHEMATICS
COURSE CODE: MVLSI101
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:
CO1: Evaluate different mathematical tools and techniques used in electrical engineering.
CO2: Apply appropriate scientific and mathematical theories and laws to solve engineering problems.
CO3: Demonstrate theoretical knowledge to use in the modern communication systems.
CO4: Apply statistical theories to solve engineering problems.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓						✓	✓
CO2	✓			✓							✓	✓
CO3	✓	✓	✓								✓	✓
CO4	✓	✓	✓		✓						✓	✓

Course Contents:

Module 1: 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.

Module 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.

Module 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.

Module 4: Probability and Statistics
Definition and postulates of probability, Field of probability, Mutually exclusive events, Byes' Theorem, Independence, Bernoulli trial, Discrete Distributions, Continuous distributions, Probable errors, Linear regression, Introduction to non-linear regression, Correlation, Analysis of variance.

Text 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

Reference Books:

1. Scarborough, J. B.-Numerical Mathematical Analysis,Oxford University Press
2. Cone, S. D.-Elementary Numerical Analysis, Mc. GrawHill.
3. Mukhopadhyay ,P.-Mathematical Statistics ,New Central Book Agency

TITLE OF COURSE: VLSI DEVICES & MODELING
COURSE CODE: MVLSI 102
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:

CO1: Understand the basic physics of semiconductor devices and the basics theory of PN junction.
CO2: Understand the basic theory of MOS transistors.
CO3: Understand the basic steps of fabrication.
CO4: Acquire knowledge about physics involved in modelling of semiconductor device.
CO5: Apply knowledge of mathematics, science, and engineering to design CMOS analog circuits to achieve performance specifications.
CO6: Analyze the issues related to trade-off between cost, speed and accuracy.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓		✓		✓				✓		✓
CO2	✓		✓		✓	✓				✓		✓
CO3	✓		✓		✓	✓	✓			✓		✓
CO4	✓		✓		✓	✓	✓			✓		✓
CO5	✓		✓		✓	✓	✓			✓		✓
CO6	✓		✓		✓		✓					✓

Course Contents:

Semiconductors, Junctions and MOSFET Overview: Introduction, Semiconductors, Conduction, Contact Potentials, P-N Junction, Overview of the MOS Transistor.
Basic Device Physics:

Two Terminal MOS Structure: Flat-band voltage, Potential balance & charge balance, Effect of Gate- substrate voltage on surface condition, Inversion, Small signal capacitance;

Three Terminal MOS Structure: Contacting the inversion layer, Body effect, Regions of inversion, Pinch-off voltage;

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, break down p-channel MOSFET,
CMOS Device Design: Scaling, Threshold voltage, MOSFET channel length
CMOS Performance Factors: Basic CMOS circuit elements; parasitic elements; sensitivity of CMOS delay to device parameters; performance factors of advanced CMOS device.

Text Books:

1. Fundamentals of Modern VLSI Devices by Yuan Taur&Tak H. Ning (Cambridge)
2. The MOS Transistor (second edition) YannisTsividi's (Oxford)

Reference Books:

1. CMOS Analog Circuit Design (Second edition) Phillip E. Allen and Douglas R. Holberg(Oxford)

TITLE OF COURSE: DIGITAL IC DESIGN
COURSE CODE: MVLSI103
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes (CO):
CO1: Model digital systems in VHDL and SystemC at different levels of abstraction.
CO2: Transfer a design from a version possible to simulate to a version possible to synthesize.
CO3: Design a circuit to perform a certain functionality with specified speed.
CO4: Study and analyze the performance of CMOS Inverter circuits on the basis of their operation and working.
CO5: Learn the basics of Fabrication and Layout of CMOS Integrated Circuits.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓			✓			✓	✓				✓
CO3	✓	✓	✓				✓	✓				✓
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓							✓

Course Contents:

Specification Methods: Language based methods including VHDL/Verilog, hierarchical state machine descriptions such as State Charts and Petri net based methods. Functional languages for formal verification.
Synthesis tools: High level synthesis; Scheduling allocation, communication and control

Module Generation: Finite State machines, state encoding, parameterized blocks PLA, RAM, ROM generation. Gate Level Synthesis; Binary Decision Diagrams, Logic minimization, optimization and retargeting.

Layout Synthesis: Placement; simulated annealing, genetic algorithms, constructive methods. Routing; nets, layers, Lees algorithms, cost functions, channel routing. Examples of a channel router with placement expansion.

Case Study: Design of MSI chip using proprietary CAD system; use of circuit description language; layout considerations.

Complex gates: pseudo NMOS; dynamic logic; dynamic cascaded logic; domino logic; 2 and 4 phase logic; pass transistor logic. Control and timing; synchronous and asynchronous; self-timed systems; multi-phase clocks; register transfer; examples of ALU, shifters, and registers. Emerging concepts: Synchronizers s and arbiters, networks on a chip.

Effects of scaling circuit dimensions: physical limits to develop fabrication. Optional extended course work for final year students, using VLSI design software to produce a chip to meet a given specification; the chip may be fabricated if the design is successful. To study the different stages in the design of integrated chip using VLSI design software. The design is to meet a given specification

Text Books:

1. CAD for VLSI: Author: Russell, G, Kinniment, D.J., Chester, E.G., and McLauchlan, M.R. Notes: Van NorstrandRheinhold, 1985.
2. Tutorial on High Level Synthesis Author: McFarland, M.C., Parker, A.C and Camposano R Notes: Proc 25th ACM/IEEE Design Automation Conf pp330-336
3. CMOS VLSI Design A Ci r cui t s and Sys tems Per spective (3rd Edi t ion) Author Neil Weste and David Harris.

University of Engineering & Management Jaipur

TITLE OF COURSE: MICROELECTRONICS TECHNOLOGY & IC FABRICATION
COURSE CODE: MVLSI 104
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes (CO):

Upon successful completion of this course, students should be able to:
CO1: Outline the basics of semiconductor crystal properties
CO2: Identify the fundamentals of IC fabrication

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓			✓								✓

Course Contents:

Cleanroom technology - Clean room concept – Growth of single crystal Si, surface contamination, cleaning & etching.

Oxidation – Growth mechanism and kinetic oxidation, oxidation techniques and systems, oxide properties, oxide induced defects, characterization of oxide films, Use of thermal oxide and CVD oxide; growth and properties of dry and wet oxide, dopant distribution, oxide quality

Solid State Diffusion – Fick's equation, atomic diffusion mechanisms, measurement techniques, diffusion in polysilicon and silicon dioxide diffusion systems.

Ion implantation – Range theory, Equipment's, annealing, shallow junction, high energy implementation. **Lithography** – Optical lithography, some advanced lithographic techniques.

Physical Vapor Deposition – APCVD, Plasma CVD, OCVD.

Metallization - Different types of metallization, uses & desired properties. VLSI Process integration.

Text Books:

1. Semiconductor Devices Physics and Technology, Author: Sze, S.M.; Notes: Wiley, 1985
2. An Introduction to Semiconductor Micro technology, Author: Morgan, D.V., and Board,
3. K Electrical and Electronic Engineering Series VLSI Technology, Author: Sze, S.M.Notes: Mcgraw-Hill

TITLE OF COURSE: ADVANCED DIGITAL COMMUNICATION
COURSE CODE: MVLSI 105
L-T-P: 3-1-0
CREDITS: 4

Course Outcomes (CO):
At the end of this course, students will be able to
CO1: Identify and describe properties and limiting effects of wireless communication channels..
CO2: Motivate the fact that the implementation and development of modern communication technology, in particular in wireless communications, requires mathematical modeling and problem solving.
CO3: Apply mathematical modeling to problems in wireless digital communications, and explain how this is used to analyze and synthesize methods and algorithms within the field.
CO4: Compare different digital commnuication techniques and judge their applicability and performance in different application scenarios.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓							✓
CO2	✓			✓								✓
CO3	✓	✓	✓									✓
CO4	✓	✓	✓		✓							✓

Course Contents:

Unit 1: Spectral analysis of signals: Orthogonal & orthonormal signals. Gram-Schmidt procedure to represent a set of arbitrary signals by a set of orthonormal components; - numerical examples. The concept of signal-space coordinate system, representing a signal vector by its orthonormal components, measure of distinguishability of signals.

Unit 2: Characteristics of random variables and random processes: Common probability density functions, - Gaussian, Rayleigh, Poisson, binomial, Rice, Laplacian, lognormal, etc. Probability of error in Gaussian Binary symmetric channel. Random processes – time average, ensemble average, covariance, autocorrelation, cross correlation, stationary process, ergodic process, wide sense stationary process. Power spectral density and autocorrelation, power spectral density of a random binary signal.
Linear mean square estimation methods.

Unit 3: Revision of source coding: Sampling theorem, instantaneous/ flat top/ natural sampling, band width of PAM signal, quantization, quantization noise, principle of pulse code modulation, delta modulation & adaptive delta modulation. Parametric coding/ hybrid coding/ sub band coding: APC, LPC, Pitch predictive, ADPCM, voice excited vocoder, vocal synthesizer.

Unit 4: Line codes: UPNRZ, PNRZ, UPRZ, PRZ, AMI, Manchester etc. Calculation of their power spectral densities. Bandwidths and probabilities of error Pe for different line codes.
Unit 5: Revision of digital modulation: Principle, transmitter, receiver, signal vectors, their distinguish ability and signal band width for BPSK, QPSK, M-ARY PSK, QASK, MSK, BFSK, M-ARY FSK.

Unit 6: Spread spectrum modulation: Principle of DSSS, processing gain, jamming margin, single tone

interference, principle of CDMA, MAI and limit of number of simultaneous users. Digital cellular CDMA system: model of forward link, reverse link, error rate performance of decoder using m-sequence chip codes. Properties of m-sequences, their generation by LFSR, their PSDs, limitations of m sequences.
Gold sequence, Kasami sequence – generating the sequences, their characteristic mean, cross correlation and variance of cross correlation, their merits and limitations as chip codes in CDMA.

Unit 7: Multiplexing & multiple access: TDM/TDMA, FDM/FDMA, Space DMA, Polarization DMA, OFDM, ALOHA, Slotted ALOHA, Reservation ALOHA, CSMA-CD, CSMA-CA – basic techniques and comparative performances e.g. signal bandwidth, delay, probability of error etc.

Unit 8: Noise: Representation of noise in frequency domain. Effect of filtering on the power spectral density of noise – Low pass filter, band pass filter, differentiating filter, integrating filter. Quadrature components of noise, their power spectral densities and probability density functions. Representation of noise in orthogonal components.

Unit 9: Characteristics of different types of channels: Gaussian, Poisson etc,

Unit 10: Band limited channel: Characteristics of band limited channel, inter symbol interference (ISI) - it's mathematical expression. Nyquist's theorem for signal design for no ISI in ideal band limited channel, Niquist's criteria, raised cosine pulse signals. Signal design for controlled ISI in ideal band limited channel, partial response signals, duobinary& partial duobinary signals - their methods of generation and detection of data. Concept of maximum likelihood detection, log likely hood ratio. Detection of data with controlled ISI by linear transverse filters. Performance of minimum mean square estimation (MMSE) detection in channels with ISI.

Unit 11: Base band signal receiver and probabilities of bit error: Peak signal to RMS noise output ration, probability of error. Optimum filter, its transfer function. Matched filter, its probability of error. Probability of error in PSK, effect of imperfect phase synchronization or imperfect bit synchronization. Probability of error in FSK, QPSK. Signal space vector approach to calculate probability of error in BPSK, BFSK, QPSK. Relation between bit error rate and symbol error rate. Comparison of various digital modulation techniques vis-à-vis band width requirement and probabilities of bit error.

Text Books

1. Digital communication, 4th ed. - J. G. Proakis, MGH International edition.
2. Principle of Communication Systems – Taub, Schilling, TMH
3. Digital and Analog Communication Systems, 7th ed. – Leon W. Couch, PHI.
4. Principles of Digital Communication – Haykin
5. Digital Communication – Zeimer, Tranter
6. Principle of Digital communication - J. Das, S. K. Mallick, P. K Chakraborty, New Age Int.
7. Communication Systems, 4th ed. – A. Bruce Carlson, Paul B. Crilly, Janet C. Rutledge, MGH International edition.

TITLE OF COURSE: CAD TOOLS FOR VLSI DESIGN
COURSE CODE: MVLSI191
L-T-P: 0-0-3
CREDITS: 4

Course Outcomes (COs):

At the end of this course, students will be able to

CO1: Students are able to know how to place the blocks and how to partition the blocks while for designing the layout for IC.

CO2: Students are able to solve the performance issues in circuit layout..

CO3: Students are able to analyze physical design problems and Employ appropriate automation algorithms for partitioning, floor planning, placement and routing.

CO4: Students are able to analyze circuits using both analytical and CAD tools.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓			✓	✓							✓
CO2		✓										
CO3			✓			✓		✓				✓
CO4						✓	✓		✓			

Course Contents:

Exercises that must be done in this course are listed below: Exercise No.1: Design of basic Gates: AND, OR, NOT. Exercise No. 2: Design of universal gates
Exercise No. 3: Design of XOR and XNOR gate. Exercise No. 4: Design of 2:1 MUX.
Exercise No. 5: Design of 2 to 4 Decoder.
Exercise No. 6: Design of Half-Adder and Full Adder. Exercise No. 7: Design of 8:3 Priority Encoder.
Exercise No. 8: Design of 4 Bit Binary to Grey Code Converter. Exercise No. 9: Design of all Flip-Flops.
Exercise No. 10: Design of Shift register. Exercise No. 11: Design of ALU.

Text Book:

1. J. Bhaskar, A VHDL Primer, 3rd edition, Prentice Hall.

University of Engineering & Management Jaipur

TITLE OF COURSE: EMBEDDED SYSTEM LAB-I
COURSE CODE: MVLSI-191
L-T-P: 0-0-3
CREDITS: 3

Course Outcomes (COs):

At the end of this course, students will be able to

CO1: understand basic concepts in the embedded computing systems area;

CO2: determine the optimal composition and characteristics of an embedded system.

CO3: design and program an embedded system at the basic level.

CO4: Apply contemporary techniques for Hardware-Software co-design of embedded systems for Real time applications using RTOS

CO5: Make use of the enabling technologies for implementing embedded systems with emphasis on Microcontrollers from various vendors and the techniques for programming their integrated peripherals using IDE programming tools in high level languages as C.

Mapping of Course Outcomes (CO) and Program Outcomes (PO):

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2				✓								
CO3				✓		✓	✓					
CO4		✓										✓
CO5					✓		✓	✓				

Course Contents:
Exercises that must be done in this course are listed below:

Exercise No.1: Write an assembly language program to add two 64 bit numbers by ARM processor, Exercise No. 2: Write an assembly language program for addition two 32 bit numbers,

Exercise No. 3: Write an assembly language program to find smallest of N numbers

Exercise No. 4: Write an assembly language program to find largest of N numbers Exercise No. 5: Write an assembly language program to convert Hex to ASCII Exercise No. 6: Write an assembly language program to convert ASCII to hex

Exercise No. 7: Write an assembly language program to generate N Fibonacci numbers

Exercise No. 8: Write an ALP to find the factorial of a given number using subroutine

Exercise No. 9: Write an assembly language program to find the multiplication of two 32-bit number

Text Book:

1. William Hohl,"ARM Assembly Language: Fundamentals and Techniques", Second Edition, CRC Press
2. Vincent Mahout, "Assembly Language Programming: ARM Cortex-M3", Wiley publication