SRINIVASA INSTITUTE OF TECHNOLOGY & SCIENCE

(AUTONOMOUS)

Approved by AICTE, New Delhi – Affiliated to JNTUA, Ananthapuramu

Accredited by NAAC with 'A' Grade

Chennai-Hyderabad Bypass Road, Ukkayapalli, Kadapa-516002

M.TECH. IN VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN

COMMON COURSE STRUCTURE & SYLLABI

(Applicable from the academic year 2024-25 onwards)

SEMESTER – I

S. No.	Course codes	Course Name	Category	Hours per week			Credits
				L	T	P	
1.	24MVD101	CMOS Analog IC Design	PC	3	0	0	3
2.	24MVD102	CMOS Digital IC Design	PC	3	0	0	3
3.	24MVD103a 24MVD103b 24MVD103c	**Program Elective– I** Microchip Fabrication Techniques Nano materials and Nano technology CAD for VLSI	PE	3	0	0	3
4.	24MVD104a 24MVD104b 24MVD104c	**Program Elective– II** Device Modelling FPGA Architectures and Applications ASIC Design	PE	3	0	0	3
5.	24MVD105	CMOS Analog IC Design Lab	PC	0	0	4	2
6.	24MVD106	CMOS Digital IC Design Lab	PC	0	0	4	2
7.	24MRM101	Research Methodology and IPR	MC	2	0	0	2
8.	24MAC101a 24MAC101b 24MAC101c	**Audit Course–I** English for Research paper writing Disaster Management Sanskrit for Technical Knowledge	AC	2	0	0	0
Total							**18**

SEMESTER – II

S. No.	Course codes	Course Name	Category	Hours per week			Credit s
				L	T	P	
1.	24MVD201	CMOS Mixed Signal IC Design	PC	3	0	0	3
2.	24MVD202	Physical Design Automation	PC	3	0	0	3
3.	24MVD203a 24MVD203b 24MVD203c	**Program Elective – III** SoC Testing and Verification Semi conductor Memory Design and Testing MEMS System Design	PE	3	0	0	3
4.	24MVD204a 24MVD204b 24MVD204c	**Program Elective – IV** Low Power VLSI Design IoT and its Applications VLSI Signal Processing	PE	3	0	0	3
5.	24MVD205	CMOS Mixed Signal IC Design Lab	PC	0	0	4	2
6.	24MVD206	Physical Design Automation Lab	PC	0	0	4	2
7.	24MVD207	Technical seminar	PR	0	0	4	2
8.	24MAC201a 24MAC201b 24MAC201c	**Audit Course–II** Pedagogy Studies Stress Management for Yoga Personality Development through Life Enlightenment Skills	AC	2	0	0	0
		Total					**18**

SEMSTER-III

S. No.	Course codes	Course Name	Category	Hours per Week			Credits
				L	T	P	
1.	24MVD301a 24MVD301b 24MVD303a	**Program Elective– V** Bi-CMOS Technology and Applications Optimization Techniques and Applications in VLSI Design SoC Architecture	PE	3	0	0	3
2.	24MOE301b 24MOE301c 24MOE301e	**Open Elective** Industrial Safety Business Analytics Waste to Energy	OE	3	0	0	3
3.	24MVD302	Dissertation Phase–I	PR	0	0	20	10
4.	24MVD303	Co-curricular Activities					2
Total							**18**

SEMESTER -IV

S. No.	Course codes	Course Name	Category	Hours per Week			Credits
				L	T	P	
1.	24MVD401	Dissertation Phase–II	PR	0	0	32	16
Total							**16**

Course Code	CMOS ANALOGIC DESIGN	L	T	P	C
24MVD101		3	0	0	3
	Semester	I			

Course Objectives:

- This course focuses on theory, analysis and design of analog integrated circuits in both Bipolar and Metal-Oxide-Silicon (MOS) technologies.
- Basic design concepts, issues and tradeoffs involved in analog IC design are explored.
- Intuitiveunderstandingandreal-lifeapplicationsareemphasizedthroughoutthecourse.
- To learn about Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power Supply Rejection Ratio of Two-Stage Op Amps, Cascade Op Amps, Measurement Techniques of OP Amp.
- To know about Characterization of Comparator, Two-Stage, Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators etc.

Course Outcomes(CO): Student will be able to

- Design MOSFET based analog integrated circuits.
- Analyze analog circuits at least to the first order.
- Appreciate the trade-offs involved in analog integrated circuit design.
- Understand and appreciate the importance of noise and distortion in analog circuits.
- AnalyzecomplexengineeringproblemscriticallyinthedomainofanalogICdesignfor conducting research.
- Solveengineeringproblemsforfeasibleandoptimalsolutionsinthecorearea

UNIT -I	Lecture Hrs:10

Basic MOS Device Physics: General Considerations, MOS I/V Characteristics, Second Order effects, MOS Device models and MOS Capacitor. Short Channel Effects and Device Models. Single Stage Amplifiers–Basic Concepts, Common Source Stage, Source Follower, Common Gate Stage, Cascode Stage.

UNIT – II	Lecture Hrs:10

Differential Amplifiers: Single Ended and Differential Operation, Basic Differential Pair, Common Mode Response, Differential Pair with MOS loads, Gilbert Cell. Passive and Active Current Mirrors–BasicCurrentMirrors,CascodeCurrentMirrors,ActiveCurrentMirrors.CurrentSteering Circuit

UNIT - III	Lecture Hrs:9

Frequency Response of Amplifiers: General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair. Noise–Types of Noise, Representation of Noise in circuits, Noise in single stage amplifiers, Noise in Differential Pairs.

UNIT - IV	Lecture Hrs:9

Feedback Amplifiers: General Considerations, Feedback Topologies, Effect of Loading. Operational Amplifiers–GeneralConsiderations,OneStageOpAmps,TwoStageOpAmps,GainBoosting, Common–Mode Feedback, Input Range limitations, Slew Rate, Power Supply Rejection, Noise in Op Amps, Stability and Frequency Compensation.

UNIT - V	Lecture Hrs:10

Comparators: Characterizationofcomparator,Two-Stage,Open-Loopcomparators,OtherOpen-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

Textbooks:

1. B.Razavi,"DesignofAnalogCMOSIntegratedCircuits",2nd Edition,McGrawHillEdition2016.
2. Paul.R.Gray&RobertG.Meyer,"AnalysisandDesignofAnalogIntegratedCircuits",Wiley,

5thEdition, 2009.
Reference Books:
1. T.C.Carusone, D.A.Johns & K.Martin, "Analog Integrated Circuit Design", 2ndEdition, Wiley, 2012. 2. P.E.Allen & D.R.Holberg, "CMOS Analog Circuit Design", 3rd Edition, Oxford University Press, 2011. 3. R.JacobBaker,"CMOSCircuitDesign,Layout,andSimulation",3rdEdition,Wiley,2010. 4. Adel S.Sedra, Kenneth C.Smith, Arun, "Microelectronic Circuits", 6thEdition,OxfordUniversity Press.

Course Code	CMOS DIGITAL IC DESIGN	L	T	P	C
24MVD102		3	0	0	3
Semester		I			

Course Objectives:

- To understand the fundamental properties of digital Integrated circuits using basic MOSFET equations and to develop skills for various logic circuits using CMOS related design styles.
- The course also involves analysis of performance metrics.
- ToteachfundamentalsofCMOSDigitalintegratedcircuitdesignsuchasimportanceof Pseudo logic, Combinational MOS logic circuits and Sequential MOS logic circuits.
- ToteachthefundamentalsofDynamiclogiccircuitsandbasicsemiconductormemories which are the basics for the design of high performance digital integrated circuits.

Course Outcomes(CO): Student will be able to

- Demonstrate advanced knowledge in Static and dynamic characteristics of CMOS,
- Estimate Delay and Power of Adders circuits.
- Classify different semi conductor memories.
- Analyze, design and implement combinational and sequential MOS logic circuits.
- AnalyzecomplexengineeringproblemscriticallyinthedomainofdigitalICdesignfor conducting research.
- Solve engineering problems for feasible and optimal solutions in the core area of digital ICs

UNIT –I — Lecture Hrs:10

MOS Design Pseudo NMOS Logic: Inverter, Inverter threshold voltage, Output high voltage, OutputLowvoltage,Gainatgatethresholdvoltage,Transientresponse,Risetime,Falltime,Pseudo NMOS logic gates, Transistor equivalency, CMOS Inverter logic.

UNIT – II — Lecture Hrs:10

Combinational MOS Logic Circuits: MOS logic circuits with NMOS loads, Primitive CMOS logic gates–NOR & NAND gate, Complex Logic circuits design–Realizing Boolean expressions using NMOSgatesandCMOSgates,AOIandOIAgates,CMOSfulladder,CMOStransmissiongates, Designing with Transmission gates.

UNIT - III — Lecture Hrs:9

Sequential MOS Logic Circuits: Behavior of bistable elements, SR Latch, Clocked latch and flip flop circuits, CMOS D latch and edge triggered flip-flop

UNIT - IV — Lecture Hrs:9

Dynamic Logic Circuits: Basic principle, Voltage Bootstrapping, Synchronous dynamic pass Transistor circuits, Dynamic CMOS transmission gate logic, High performance Dynamic CMOS circuits.

UNIT – V — Lecture Hrs:10

Semiconductor Memories: Types, RAM array organization, DRAM–Types, Operation, Leakage currents in DRAM cell and refresh operation, SRAM operation Leakage current sin SRAM cells, Flash Memory-NOR flash and NAND flash.

Textbooks:

1. NeilWeste, DavidHarris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson, 2010
2. Digital Integrated Circuit Design–Ken Martin, Oxford University Press, 2011.
3. CMOS Digital Integrated Circuits Analysis and Design–Sung-MoKang, Yusuf Leblebici, TMH, 3rd Edition, 2011.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective – Ming-BO Lin, CRC Press, 2011.
2. Digital Integrated Circuits–A Design Perspective, Jan M.Rabaey, Anantha Chandrakasan, Borivoje Nikolic, 2ndEdition, PHI.

Course Code	MICRO CHIP FABRICATION TECHNIQUES	L	T	P	C
24MVD103a	Program Elective– I	3	0	0	3
	Semester	I			

Course Objectives:

- Comprehend impact of semiconductor industry on the design of development of integrated circuits.
- Acquaint with clean room technology
- Understand oxidation methods, aspects of photolithography, diffusion, ion implantation techniques.
- Specify NMOS and CMOS design rules corresponding to 180nm, 90nm and 45nm technologies
- Understand packaging principles

Course Outcomes(CO): Student will be able to

- Understand various stages of fabrication
- Understand various packaging techniques and Design rules.
- Classify various thin film sand its characteristics.

UNIT –I	Lecture Hrs:10

Introduction to Processing: Overview of semiconductor industry, Stages of Manufacturing, Process and product trends, Crystal growth, Basic wafer fabrication operations, process yields, Semiconductormaterialpreparation,Yieldmeasurement,Contaminationsources,Cleanroom Construction.

UNIT – II	Lecture Hrs:10

Photolithography: Oxidation and Photolithography, Ten step patterning process, Photoresists, physical properties of photoresists, Storage and control of photoresists, photo masking process, Hard bake, develop inspect, Dry etching Wet etching, resist stripping.

UNIT – III	Lecture Hrs:9

Diffusion& Ion Implantation: Doping and depositions: Diffusion process steps, deposition, Drive-in oxidation, Ion implantation-1, Ion implantation-2.

UNIT – IV	Lecture Hrs:9

Film Depositions and Growth: Metallization, CVD basics, CVD process steps, Low pressure CVD systems, Plasma enhanced CVD systems, Vapour phase epitaxy, molecular beam epitaxy.

UNIT – V	Lecture Hrs:10

Yield: Design rules and Scaling, BICMOSICs: Choice of transistor types, PNP transistors, Resistors, capacitors.
Packaging: Chip characteristics, package functions, package operations.

Text Books:

1. PeterVanZant, Microchip fabrication, Mc GrawHill, 1997.
2. Plummer, J.D.,Deal, M.D. and Griffin, P.B., "Silicon VLSI Technology: Fundamentals, Practice and Modeling", 3rd Ed., Prentice-Hall, 2000.

Reference Books

1. C.Y. Chang and S.M.Sze, ULSI technology, Mc Graw Hill, 2000
2. S.K.Gandhi, VLSI Fabrication principles, John Wiley and V Sons, NY,1994
3. S.M.Sze, VLSI technology, Mc Graw-Hill Book company, NY, 1988

Course Code	NANOMATERIALS AND NANOTECHNOLOGY	L	T	P	C
24MVD103b	Program Elective– I	3	0	0	3
	Semester	I			

Course Objectives:

- To understand the basic idea behind the design and fabrication of nano scale systems.
- To understand and formulate new engineering solutions for current problems and technologies for future applications.
- To acquire knowledge on the operation of fabrication and characterization devices to achieve precisely designed systems.

Course Outcomes(CO): Student will be able to

- Understand the basic science behind the design and fabrication of nano scale systems.
- Understand and formulate new engineering solutions for current problems and competing technologies for future applications.
- Make interdisciplinary projects applicable to wide areas by clearing and fixing the boundaries in system development.
- Gather detailed knowledge of the operation of fabrication and characterization devices to achieve precisely designed systems.

UNIT –I Lecture Hrs:10

Introduction of nano materials and nanotechnologies Features of nanostructures, Applications of nano materials and technologies. Nano dimensional Materials 0D, 1D, 2D structures – Size Effects – Fraction of Surface Atoms –Specific Surface Energy and Surface Stress – Effect on the Lattice Parameter – Phonon Density of States – the General Methods available for the Synthesis of Nanostructures–precipitate–reactive–hydrothermal/solvothermalmethods–suitabilityofsuch Methods for scaling–potential Uses.

UNIT - II Lecture Hrs:9

Fundamentals of nano materials, Classification, Zero-dimensional nano materials, One-dimensional nano materials, Two-dimensional nano materials, three dimensional nano materials. Low Dimensional Nano materials and its Applications, Synthesis, Properties and applications of Low Dimensional Carbon- Related Nano materials.

UNIT - III Lecture Hrs:10

Micro-and Nanolithography Techniques, Emerging Applications, Introduction to Micro electro mechanical Systems (MEMS), Advantages and Challenges of MEMS, Fabrication Technologies, Surface Micromachining, Bulk Micromachining, Molding. Introduction to Nano Phonics.

UNIT - IV Lecture Hrs:10

Introduction, Synthesis of CNTs - Arc-discharge, Laser-ablation, Catalytic growth, Growth mechanisms of CNT‟s - Multi-walled nano tubes, Single-walled nano tubes Optical properties of CNT‟s, Electrical transport in perfect nano tubes, Applications as case studies. Synthesis and Applications of CNTs.

UNIT – V Lecture Hrs:9

Ferroelectric materials, coating, molecular electronics and nano electronics, biological and environmental, membrane based application, polymer based application.

Textbooks:

1. Kenneth J.Klabunde and Ryan M.Richards, “Nanoscale Materialsin Chemistry”, 2nd edition, John Wiley and Sons, 2009.
2. I Gusev and A Rempel, “Nanocrystalline Materials”, Cambridge International Science Publishing, 1st Indian edition by Viva Books Pvt. Ltd. 2008.
3. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, James Murday, “Nanoscience and Nanotechnology”, Tata Mc Graw Hill Education 2012.

Reference Books:

1. Digital Integrated Circuit Design–Ken Martin, Oxford University Press, 2011.
2. Digital Integrated Circuits-A Design Perspective, Jan M. Rabaey, Anant Chandrakasan, Borvivoje Nikolic, 2nd Edition, PHI.

Course Code	CAD FOR VLSI	L	T	P	C
24MVD103c	Program Elective– I	3	0	0	3
	Semester	I			

Course Objectives:

- To understand the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- To demonstrate knowledge and understanding of fundamental concepts in CAD and to establish capability for CAD tool development and enhancement.
- To practice the application of fundamentals of VLSI technologies
- To optimize the implemented design for area, timing and power by applying suitable constraints.

Course Outcomes(CO): Student will be able to

- Establish comprehensive understanding of the various phases of CAD for digital electronic systems, from digital logic simulation to physical design, including test and verification.
- Demonstrate knowledge and understanding of fundamental concepts in CAD and to establish capability for CAD tool development and enhancement.
- Practice the application of fundamentals of VLSI technologies
- Optimize the implemented design for area, timing and power by applying suitable constraints.

UNIT –I	Lecture Hrs:10

Introduction: VLSI Design Cycle, New Trends in VLSI Design Cycle, Physical Design Cycle, New Trends in Physical Design Cycle, Design Styles, System Packaging Styles.

UNIT – II	Lecture Hrs:9

Partitioning: Partitioning, Pin Assignment and Placement: Partitioning–Problem formulation, Classification of Partitioning algorithms, Kernighan-Lin Algorithm, Simulated Annealing.

UNIT – III	Lecture Hrs:10

Floor Planning : Floor Planning – Problem formulation, Classification of floor planning algorithms, constraint based floor planning, Rectangular Dualization, Pin Assignment–Problem formulation, Classification of pin assignment algorithms, General and channel pin assignments.

UNIT – IV	Lecture Hrs:10

Placement and Routing : Placement–Problem formulation, Classification of placement algorithms, Partitioning based placement algorithms.

Global Routing and Detailed Routing: Global Routing – Problem formulation, Classification of global routing algorithms, Maze routing algorithms, Detailed Routing – Problem formulation, Classification of routing algorithms, Single layer routing algorithms.

UNIT-V	Lecture Hrs:9

Physical Design Automation of FPGAs and MCMs: FPGA Technologies, Physical Design cycle for FPGAs, Partitioning, Routing–Routing Algorithm for the Non-Segmented model, Routing Algorithms for the Segmented Model; Introduction to MCM Technologies, MCM Physical Design Cycle.

Textbooks:

1. Algorithms for VLSI Physical Design Automation by Naveed Shervani, 3rdEdition, 2005, Springer International Edition.
2. CMOS Digital Integrated Circuits Analysis and Design–Sung-MoKang,YusufLeblebici, TMH, 3rd Ed., 2011.

Reference Books:

1. VLSI Physical Design Automation-Theory and Practice by Sadiq M Sait, Habib Youssef, World Scientific.
2. Algorithms for VLSI Design Automation, S. H. Gerez, 1999, Wiley student Edition, John Wiley and Sons (Asia) Pvt. Ltd.
3. VLSI Physical Design Automation by Sung Kyu Lim, Springer International Edition.

Course Code	DEVICE MODELLING	L	T	P	C
24MVD104a	Program Elective– II	3	0	0	3
	Semester	I			

Course Objectives:

- To understand the physics of 2-terminal MOS operation and its characteristics
- To understand the physics of 4-terminal MOSFET operation and its characteristics.
- To analyze the SOIMOSFET electrical characteristics.

Course Outcomes(CO): Student will be able to

- Understand the physics of 2-terminal MOS operation and its characteristics
- Understand the physics of 4-terminal MOSFET operation and its characteristics.
- Analyze the SOIMOSFET electrical characteristics.

UNIT –I	Lecture Hrs:9

2-terminal MOS device: threshold voltage modeling (ideal case as well as considering the effects of Qf, Φms and Dit.).

UNIT – II	Lecture Hrs:9

C-V characteristics (ideal case as well as taking into account the effects of Qf, Φms and Dit); MOS capacitor as a diagnostic tool (measurement of non-uniform doping profile, estimation of Qf, Φms And Dit.)

UNIT - III	Lecture Hrs:10

4-terminal MOSFET: threshold voltage (considering the substrate bias); above threshold I-V Modeling (SPICE level1, 2, 3 and 4).

UNIT - IV	Lecture Hrs:10

Sub threshold current model; scaling; effect of threshold tailoring implant (analytical modelling of threshold voltage using box approximation); buried channel MOSFET. Short channel, DIBL and Narrow width effects; small signal analysis of MOSFETs (Meyer's model)

UNIT – V	Lecture Hrs:10

SOIMOSFET: Basic structure; threshold voltage modeling Advanced topics: hot carriers in Channel; EEPROMs; CCDs; high-K gate dielectrics.

Textbooks:

1. S.M. Sze, Physics of Semiconductor Devices, (2e), Wiley Eastern, 1981.
2. M. Lundstrom, Fundamentals of Nanotransistors, World Scientific Publishing Co Pte Ltd 2017.

Reference Books

1. Y.P.Tsividis, Operation and Modelling of the MOS Transistor, McGraw-Hill, 1987.
2. E.Takeda, Hot-carrier Effects in MOS Transistors, Academic Press, 1995.
3. J.P. Colinge, "FinFETs and Other Multi-Gate Transistors, "Springer.2009

Course Code	FPGA ARCHITECTURES AND APPLICATIONS	L	T	P	C
24MVD104b	Program Elective– II	3	0	0	3
	Semester	I			

Course Objectives:

- To acquire knowledge about various architectures and device technologies of PLD's.
- To comprehend FPGA Architectures.
- To analyze System level Design and their application for Combinational and Sequential Circuits.
- To familiarize with Anti-Fuse Programmed FPGAs.
- To apply knowledge of this subject for various design applications.

Course Outcomes(CO): Student will be able to

- Acquire knowledge about various architectures and device technologies of PLD's.
- Comprehend FPGA Architectures.
- Analyze System level Design and their application for Combinational and Sequential Circuits.
- Familiarize with Anti-Fuse Programmed FPGAs.
- Apply knowledge of this subject for various design applications.

UNIT –I		Lecture Hrs:10

Introduction to Programmable Logic Devices: Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Programmable Logic Devices/Generic Array Logic; Complex Programmable Logic Devices–Architecture of Xilinx Cool Runner XCR3064XL CPLD, CPLD Implementation of a Parallel Adder with Accumulation.

UNIT - II	Field Programmable Gate Arrays	Lecture Hrs:10

Field Programmable Gate Arrays: Organization of FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, and Applications of FPGAs.

UNIT - III		Lecture Hrs:9

SRAM Programmable FPGAs: Introduction, Programming Technology, Device Architecture, the XilinxXC2000, XC3000 and XC4000 Architectures.

UNIT - IV		Lecture Hrs:10

Anti-Fuse Programmed FPGAs: Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT – V		Lecture Hrs:9

Design Applications: General Design Issues, Counter Examples, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices, Designing Adders and Accumulators with the ACT Architecture.

Textbooks:

1. Field Programmable Gate Array Technology-Stephen M.Trimberger, Springer International Edition.
2. Digital Systems Design-Charles H.Roth Jr, Lizy Kurian John, Cengage Learning.

Reference Books:

1. Field Programmable Gate Arrays-JohnV.Oldfield, Richard C.Dorf, Wiley India.
2. Digital Design Using Field Programmable Gate Arrays - Pak K. Chan/Samiha Mourad, Pearson Low Price Edition.
3. Digital Systems Design with FPGAs and CPLDs-Ian Grout, Elsevier, Newnes.
4. FPGA based System Design-Wayne Wolf, Prentice Hall Modern Semiconductor Design Series.

Course Code	ASIC DESIGN	L	T	P	C
24MVD104c	Program Elective– II	3	0	0	3
	Semester	I			

Course Objectives:

- To understand different types of ASICs and their libraries.
- To understand about programmable ASICs, I/O modules and their inter connects.
- To familiarize different methods of software ASIC design their simulation, testing and construction of ASICs.

Course Outcomes(CO): Student will be able to

- Understand different types of ASICs and their libraries.
- Understand about programmable ASICs, I/O modules and their inter connects.
- Familiarize different methods of software ASIC design their simulation, testing and construction of ASICs.

UNIT –I — Lecture Hrs:9

Introduction to ASICs: Types of ASICs, Design Flow, Case Study, Economics of ASICs, ASIC Cell Libraries, Transistors as resistors, Transistor Parasitic Capacitance, Logical Effort, Library Cell Design, Library Architecture, Gate-Array Design, Standard Cell Design, Data Path Cell Design.

UNIT – II — Lecture Hrs:10

Programmable ASICs and Programmable ASIC Logic Cells: The Anti fuse, Static Ram, EPROM and EEPROM Technology, Practical Issues, Specifications, PREDP Benchmarks, FPGA Economics, Actel ACT, Xilinx LCA, Altera Flex, Altera Max.

UNIT – III — Lecture Hrs:9

I/O Cells and Interconnects & Programmable ASIC Design Software: DC Output, AC Output, DC input, AC input, Clock input, Power input, Xilinx I/O block, Other I/O Cells, Actel ACT, Xilinx LCA, Xilinx EPLD, Altera Max 5000 and 7000, Altera Max 9000, Altera FLEX, Design Systems, Logic Synthesis, The Half gate ASIC.

UNIT – IV — Lecture Hrs:10

Low Level Design Entry and Logic Synthesis: Schematic Entry, Low level Design Languages, PLA Tools, EDIF, A logic synthesis example, A Comparator/MUX, Inside a Logic Synthesizer, Synthesis of Viterbi Decoder, Verilog and Logic synthesis, VHDL and Logic Synthesis, Finite State Machine Synthesis, Memory Synthesis, The Engine Controller, Performance Driven Synthesis, Optimization of the viterbi decoder.

UNIT – V — Lecture Hrs:10

Simulation, Test and ASIC Construction: Types of Simulation, The Comparator/MUX Example, Logic Systems, How Logic Simulation Works, Cell Models, Delay Models, Static Timing Analysis, Formal Verification, Switch Level Simulation, Transistor Level Simulation, The importance of test, Boundary Scan Test, Faults, Faults Simulation, Automatic Test Pattern Generator, Scan Test, Built in Self-Test,AsimpletestExample,PhysicalDesign,CADTools,SystemPartitioning,Estimating ASIC Size, Power Dissipation, FPGA Partitioning, Partitioning Methods

Textbooks:

1. Michael John Sebastian Smith, “Application Specific Integrated Circuits”, Pearson Education, 2003.
2. L.J. Herbst, “Integrated Circuit Engineering”, Oxford Science Publications, 1996.

Reference Books:

1. Himanshu Bhatnagar, “Advanced ASIC Chip Synthesis using Synopsis Design Compiler”,2nd Edition, Kluwer Academic, 2001.

Course Code	CMOS ANALOG IC DESIGN LAB	L	T	P	C
24MVD105		0	0	4	2
	Semester	I			

Course Objectives:

- To explain the VLSI Design Methodologies using VLSI design tool.
- To grasp the significance of various CMOS analog circuits in full-custom IC Design flow
- To explain the Physical Verification in Layout Design
- To fully appreciate the design and analyze of analog and mixed signal simulation
- To grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation

Course Outcomes(CO):

- Explain the VLSI Design Methodologies using VLSI design tool.
- Grasp the significance of various CMOS analog circuits in full-custom IC Design flow
- Explain the Physical Verification in Layout Design
- Fully appreciate the design and analyze of analog and mixed signal simulation
- Grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation

List of Experiments:

- The students are required to design and implement any **TEN** Experiments using CMOS 130nm Technology.
- The students are required to implement LAYOUTS of any **SIX** Experiments using CMOS 130nm Technology and Compare the results with Pre-Layout Simulation.

1. MOS Device Characterization and parametric analysis
2. Common Source Amplifier
3. Common Source Amplifier with source degeneration
4. Cascode amplifier
5. Simple current mirror
6. Cascode current mirror.
7. Wilson current mirror.
8. Differential Amplifier
9. Operational Amplifier
10. Sample and Hold Circuit
11. Direct-conversion ADC
12. R-2RLadder Type DAC

Lab Requirements:

Software:

Mentor Graphics–Pyxis Schematic, IC Station, Calibre, ELDO Simulator

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

Course Code	CMOS DIGITAL IC DESIGN LAB	L	T	P	C
24MVD106		0	0	4	2
	Semester	**I**			

Course Objectives:

- To explain the VLSI Design Methodologies using any VLSI design tool.
- To grasp the significance of various design logic Circuits in full-custom IC Design.
- To explain the Physical Verification in Layout Extraction.
- To fully appreciate the design and analyze of CMOS Digital Circuits.
- To grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation.

Course Outcomes(CO):

- Explain the VLSI Design Methodologies using any VLSI design tool.
- Grasp the significance of various design logic Circuits in full-custom IC Design.
- Explain the Physical Verification in Layout Extraction.
- Fully appreciate the design and analyze of CMOS Digital Circuits.
- Grasp the Significance of Pre-Layout Simulation and Post-Layout Simulation.

List of Experiments:

The students are required to design an dimplement the Circuit and Layout of any **TEN** Experiments using CMOS130nm Technology.

1. Inverter Characteristics.
2. NAND and NOR Gate
3. XOR and XNOR Gate
4. 2:1 Multiplexer
5. Full Adder
6. RS-Latch
7. Clock Divider
8. JK-Flip Flop
9. Synchronous Counter
10. Asynchronous Counter
11. Static RAM Cell
12. Dynamic Logic Circuits
13. Linear Feedback Shift Register

Lab Requirements:

Software:

Mentor Graphics Tool/Cadence/Synopsys/Industry Equivalent Standard Software

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

Course Code	RESEARCH METHODOLOGY AND IPR	L	T	P	C
24MRM101		2	0	0	2
	Semester	I			

Course Objectives:

- Identify an appropriate research problem in their interesting domain.
- Understand ethical issues understand the Preparation of a research project thesis report.
- Understand the Preparation of a research project thesis report
- Understand the law of patent and copy rights.
- Understand the Adequate knowledge on IPR

Course Outcomes(CO): Student will be able to

- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals &nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among Students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT - I		Lecture Hrs:10

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, scope, and objectives of research problem. Approaches of investigationofsolutionsforresearchproblem,datacollection,analysis,interpretation,Necessary Instrumentations

UNIT - II		Lecture Hrs:9

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT - III		Lecture Hrs: 10

Nature of Intellectual Property: Patents, Designs, Trade and Copy right. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT - IV		Lecture Hrs:10

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT - V		Lecture Hrs:9

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Textbooks:

1. StuartMelvilleandWayneGoddard,"Researchmethodology:anintroductionforscience& engineering students'"
2. WayneGoddardandStuartMelville,"ResearchMethodology:AnIntroduction"

Reference Books:

1. RanjitKumar,2ndEdition,"ResearchMethodology:AStepbyStepGuidefor beginners"
2. Halbert,"ResistingIntellectualProperty",Taylor&FrancisLtd,2007.
3. Mayall,"IndustrialDesign",McGrawHill,1992.
4. Niebel,"ProductDesign",McGrawHill,1974.
5. Asimov,"IntroductiontoDesign",PrenticeHall, 1962.
6. Robert P.Merges, Peter S. Menell, MarkA. Lemley, "Intellectual Property in New Technological Age", 2016.

Course Code	CMOS MIXED SIGNAL IC DESIGN	L	T	P	C
24MVD201		3	0	0	3
	Semester	**II**			

Course Objectives:

- To demonstrate first order filter with least interference
- ToextendtheconceptofphaselockedloopfordesigningPLLapplicationwithminimum jitter by considering non ideal effects.
- TodesigndifferentA/D,D/A,modulators,demodulatorsanddifferentfilterforrealtime applications

Course Outcomes(CO): Student will be able to

- Demonstrate first order filter with least interference
- Extend the concept of phase locked loop for designing PLL application with minimum jitter by considering non ideal effects.
- Design different A/D, D/A, modulators, demodulators and different filter for real time applications

UNIT -I — Lecture Hrs:9

Switched Capacitor Circuits: Introduction to Switched Capacitor circuits- basic building blocks, Operation and Analysis, Non-ideal effects in switched capacitor circuits, Switched capacitor integrators, first order filters, Switch sharing, bi quad filters.

UNIT–II — Lecture Hrs:10

Phased Lock Loop(PLL): Basic PLL topology, Dynamics of simple PLL, Charge pump PLLs-Lock acquisition, Phase/Frequency detector and charge pump, Basic charge pump PLL, Non-ideal effects in PLLs- PFD/CP non-idealities, Jitter in PLLs, Delay locked loops, applications.

UNIT - III — Lecture Hrs:9

Data Converter: Fundamentals DC and dynamic specifications, Quantization noise, Nyquist rate D/A converters-Decoder based converters, Binary-Scaled converters, Thermometer-code converters, Hybrid converters.

UNIT - IV — Lecture Hrs:10

A to D Converters: Nyquist Rate A/D Converters Successive approximation converters, Flash converter, Two-step A/D converters, Interpolating A/D converters, Folding A/D converters, Pipelined A/D converters, Sigma Delta A/D converters, Time-inter leaved converters.

UNIT - V — Lecture Hrs:10

OversamplingConverters: Noiseshapingmodulators,Decimatingfiltersandinterpolatingfilters, Higherordermodulators,Deltasigmamodulatorswithmultibitquantizers,DeltasigmaD/A

Textbooks:

1. Design of Analog CMOS Integrated Circuits-Behzad Razavi,TMH Edition,2002
2. CMOS Analog Circuit Design - Philip E. Allenand Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
3. Analog Integrated Circuit Design-David A. Johns, Ken Martin, Wiley Student Edition, 2013

Reference Books:

1. CMOS Integrated Analog-to- Digital and Digital-to-Analog converters- Rudy Van De Plassche, Kluwer Academic Publishers, 2003
2. Understanding Delta-Sigma Data converters-Richard Schreier, Wiley Interscience, 2005.
3. CMOS Mixed-Signal Circuit Design-R. JacobBaker, Wiley Interscience, 2009

Course Code	PHYSICAL DESIGN AUTOMATION	L	T	P	C
24MVD202		3	0	0	3
	Semester	II			

Course Objectives:

- To understand relation between automation algorithms and constraints posed by VLSI technology.
- To adopt algorithms to meet critical design parameters.
- To design area efficient logics by employing different routing algorithms and shape functions.
- To simulate and synthesis different combinational and sequential logics.

Course Outcomes(CO): Student will be able to

- Understand relation between automation algorithms and constraints posed by VLSI technology.
- Adopt algorithms to meet critical design parameters.
- Design area efficient logics by employing different routing algorithms and shape functions.
- Simulate and synthesis different combinational and sequential logics.

UNIT –I	Lecture Hrs:9

VLSI Design Automation Tools: Algorithms and system design, Structural and logic design, Transistor level design, Layout design, Verification methods, Design management tools.

UNIT – II	Lecture Hrs:9

Layout: Compaction, placement and routing, Design rules, symbolic layout, Applications of compaction. Formulation methods, Algorithms for constrained graph compaction, Circuit representation, Wire length estimation, Placement algorithms, Partitioning algorithms.

UNIT - III	Lecture Hrs:10

Floor planning and routing: Floor planning concepts, Shape functions and floor planning sizing, Local routing, Area routing, Channel routing, global routing and its algorithms.

UNIT - IV	Lecture Hrs:10

Simulation and Logic Synthesis: Gate level and switch level modeling and simulation, Introduction to combinational logic synthesis, ROBDD principles, implementation, construction and manipulation, Two level logic synthesis.

UNIT – V	Lecture Hrs:10

High-Level Synthesis: Hardware model for high level synthesis, internal representation of input algorithms, Allocation, assignment and scheduling, scheduling algorithms, Aspects of assignment, High level transformations.

Textbooks:

1. S.H.Gerez, Algorithms for VLSI Design Automation, John Wiley, 1998.
2. N.A.Sherwani, Algorithms for VLSI Physical Design Automation,(3/e), Kluwer,1999.

Reference Books:

1. S.M.Sait, H.Youssef, VLSI Physical Design Automation, World scientific, 1999.
2. M.Sarrafzadeh, Introduction to VLSI Physical Design, McGraw Hill(IE), 1996

Course Code	SoC TESTING AND VERIFICATION	L	T	P	C
24MVD203a	Program Elective– III	3	0	0	3
	Semester	II			

Course Objectives:

- To understand the concepts of faults and testing in SoC
- To implement the faults using simulation tools
- To analyze BIST systems

Course Outcomes(CO): Student will be able to

- Understand the concepts of faults and testing in SoC
- Implement the faults using simulation tools
- Analyze BIST systems

UNIT –I	Lecture Hrs:9

Introduction to Testing: Testing Philosophy, Role of Testing, Digital and Analog VLSI Testing, VLSI Technology Trends affecting Testing, Types of Testing, Fault Modeling: Defects, Errors and Faults, Functional Versus Structural Testing, Levels of Fault Models, Single Stuck-at Fault.

UNIT - II	Lecture Hrs:10

Logic and Fault Simulation: Simulation for Design Verification and Test Evaluation, Modeling Circuits for Simulation, Algorithms for True-value Simulation, Algorithms for Fault Simulation.

UNIT - III	Lecture Hrs:10

Testability Measures: SCOAP Controllability and Observablity, High Level Testability Measures, Digital DFT and Scan Design: Ad-Hoc DFT Methods, Scan Design, Partial-Scan Design, Variations of Scan.

UNIT - IV	Lecture Hrs:9

Built-In Self-Test: The Economic Case for BIST, Random Logic BIST: Definitions, BIST Process, Pattern Generation, Response Compaction, Built-In Logic Block Observers, Test-Per-Clock, Test-Per-Scan BIST Systems, Circular Self Test Path System, Memory BIST, Delay Fault BIST.

UNIT – V	Lecture Hrs:10

Boundary Scan Standard: Motivation, System Configuration with Boundary Scan: TAP Controller and Port, Boundary Scan Test Instructions, Pin Constraints of the Standard, Boundary Scan Description Language: BDSL Description Components, Pin Descriptions.

Textbooks:

1. M.L. Bushnell, V. D. Agrawal, "Essentials of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers.
2. M.Abramovici, M.A.Breuerand A.DFriedman, "Digital Systemsand Testable Design", Jaico Publishing House.

Reference Books:

1. P.K.Lala, "Digital Circuits Testing and Testability", Academic Press.

Course Code	SEMICONDUCTOR MEMORY DESIGN AND TESTING	L	T	P	C
24MVD203b	Program Elective– III	3	0	0	3
	Semester	II			

Course Objectives:

- To understand different types of memories, their architectural and different packing techniques of memories.
- To build fault models for memory testing.
- To analyze different parameters that lead malfunctioning of memories.
- To design reliable memories with efficient architecture to improve processes times and power.

Course Outcomes(CO): Student will be able to

- Get complete knowledge regarding different types of memories, their architectural and different packing techniques of memories.
- Build fault models for memory testing.
- Analyze different parameters that lead malfunctioning of memories.
- Design reliable memories with efficient architecture to improve processes times and power.

UNIT –I Lecture Hrs:10

Random Access Memory Technologies : SRAM – SRAM Cell structures, MOS SRAM Architecture, MOS SRAM cell and peripheral circuit operation, Bipolar SRAM technologies, SOI technology, Advanced SRAM architectures and technologies, Application specific SRAMs, DRAM–DRAM technology development, CMOS DRAM, DRAM cell theory and advanced cell structures, BICMOS DRAM, soft error failure in DRAM, Advanced DRAM design and architecture, Application specific DRAM.

UNIT - II Lecture Hrs:10

Non-volatile Memories: Masked ROMs, High density ROM, PROM, Bipolar ROM, CMOS PROMS, EPROM, Floating gate EPROM cell, Onetime programmable EPROM, EEPROM, EEPROM technology and architecture, Non-volatile SRAM, Flash Memories (EPROM or EEPROM), advanced Flash memory architecture.

UNIT - III Lecture Hrs:9

Memory Fault Modeling Testing and Memory Design for Testability and Fault Tolerance : RAM fault modeling, Electrical testing, Pseudo Random testing, Megabit DRAM Testing, non-volatile memory modeling and testing, IDDQ fault modeling and testing, Application specific Memory testing, RAM fault modeling, BIST techniques for memory.

UNIT - IV Lecture Hrs:9

Semiconductor Memory Reliability and Radiation Effects: General reliability issues RAM failure modes and mechanism, Non-volatile memory reliability, reliability modeling and failure rate prediction, Design for Reliability, Reliability Test Structures, Reliability Screening and qualification, Radiation effects, Single Event Phenomenon (SEP), Radiation Hardening techniques, Radiation Hardening Process and Design Issues, Radiation Hardened Memory characteristics, Radiation Hardness Assurance and Testing, Radiation Dosimetry, Water Level Radiation Testing and Test structures.

UNIT – V Lecture Hrs:10

Advanced Memory Technologies and High-density Memory Packing Technologies
Ferro electric RAMs (FRAMs), GaAs FRAMs, Analog memories, magneto resistive RAMs (MRAMs), Experimental memory devices, Memory Hybrids and MCMs (2D), Memory Stacks and MCMs (3D), Memory MCM testing and reliability issues, Memory cards, High Density Memory.

Packaging Future Directions.
Textbooks:
1. Semiconductor Memories Technology–Ashok K. Sharma, 2002, Wiley. 2. Advanced Semiconductor Memories – Architecture, Design and Applications - Ashok K. Sharma, 2002, Wiley.
Reference Books:
1. Modern Semiconductor Devices for Integrated Circuits–Chenming CHu, First Edition. Prentice all.

Course Code	MEMS SYSTEM DESIGN	L	T	P	C
24MVD203c	Program Elective– III	3	0	0	3
	Semester	II			

Course Objectives:

- To understand the basic concepts of MEMS technology and working of MEMS devices.
- To understand and select different materials for current MEMS devices and competing technologies for future applications.
- To understand the concepts of fabrication process of MEMS, Design and Packaging Methodology.
- To analyze the various fabrication techniques in the manufacturing of MEMS Devices.

Course Outcomes(CO): Student will be able to

- Understand the basic concepts of MEMS technology and working of MEMS devices.
- Understand and select different materials for current MEMS devices and competing technologies for future applications.
- Understand the concepts of fabrication process of MEMS, Design and Packaging Methodology.
- Analyze the various fabrication techniques in the manufacturing of MEMS Devices.

UNIT -I	Lecture Hrs:10

Introduction to MEMS: Introduction to MEMS & Real world Sensor/Actuator examples (DMD, Air-bag, pressure sensors). MEMS Sensors in Internet of Things (IoT), Bio-Medical Applications.

UNIT - II	Lecture Hrs:9

MEMS Materials and Their Properties: Materials (eg. Si, SiO2, SiN, Cr, Au, Ti, SU8, PMMA, Pt); Important properties: Young modulus, Poisson's ratio, density, piezo-resistive coefficients, TCR, Thermal Conductivity, Material Structure. Understanding Selection of materials based on applications.

UNIT - III	Lecture Hrs:9

MEMS Fab Processes – 1: Understanding MEMS Processes & Process parameters for: Cleaning, Growth & Deposition, Ion Implantation & Diffusion, Annealing, Lithography. Understanding Selection of Fab processes based on Applications.

UNIT - IV	Lecture Hrs:10

MEMS Fab Processes – 2: Understanding MEMS Processes & Process parameters for: Wet & Dry etching, Bulk & Surface Micro machining, Die, Wire & Wafer Bonding, Dicing, and Packaging. Understanding selection of Fab processes based on Applications.

UNIT - V	Lecture Hrs:10

MEMS Devices: Architecture, working and basic quantitative behavior of Cantilevers, Micro heaters, Accelerometers, Pressure Sensors, Micro mirrors in DMD, Inkjet printer-head. Understanding steps involved in Fabricating above devices.

Textbooks:

1. An Introduction to Micro electromechanical Systems Engineering; 2nd Edition by N.Maluf, K Williams; Publisher: Artech House Inc
2. Practical MEMS-by Ville Kaajakari; Publisher: Small Gear Publishing
3. Micro system Design-by S. Senturia; Publisher: Springer

Reference Books:

1. Analysis and Design Principles of MEMS Devices–Minhang Bao; Publisher: Elsevier Science.
2. Fundamentals of Micro fabrication-by M. Madou; Publisher: CRC Press; 2nd edition
3. Micro Electro Mechanical System Design-by J. Allen; Publisher: CRC Press
4. Micro machined Transducers Source book-by G. Kovacs; Publisher: McGraw-Hill

Course Code	LOW POWER VLSI DESIGN	L	T	P	C
24MVD204a	Program Elective– IV	3	0	0	3
	Semester	II			

Course Objectives:

- To understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- To implement Low power design approaches for system level and circuit level measures.
- To design low power adders, multipliers and memories for efficient design of systems.

Course Outcomes(CO): Student will be able to

- Understand the concepts of velocity saturation, Impact Ionization and Hot Electron Effect
- Implement Low power design approaches for system level and circuit level measures.
- Design low power adders, multipliers and memories for efficient design of systems.

UNIT –I Lecture Hrs:10

Fundamentals: Need for Low Power Circuit Design, Sources of Power Dissipation–Static and Dynamic PowerDissipation,ShortCircuitPowerDissipation,GlitchingPowerDissipation,Short Channel Effects –Drain Induced Barrier Lowering and Punch Through, Surface Scattering, Velocity Saturation, Impact Ionization, Hot Electron Effect.

UNIT - II Lecture Hrs:9

Low-Power Design Approaches: Low-Power Design through Voltage Scaling – VTCMOS circuits, MTCMOS circuits, Architectural Level Approach–Pipelining and Parallel Processing Approaches. Switched Capacitance Minimization Approaches: System Level Measures, Circuit Level Measures, Mask level Measures.

UNIT - III Lecture Hrs:10

Low-Voltage Low-Power Adders: Introduction, Standard Adder Cells, CMOS Adder's Architectures – Ripple Carry Adders, Carry Look Ahead Adders, Carry Select Adders, Carry Save Adders,Low-VoltageLow-PowerDesignTechniques–TrendsofTechnologyandPowerSupply Voltage, Low-Voltage Low-Power Logic Styles.

UNIT - IV Lecture Hrs:9

Low-Voltage Low-PowerMultipliers: Introduction,OverviewofMultiplication,Typesof MultiplierArchitectures,BraunMultiplier,BaughWooleyMultiplier,BoothMultiplier,Introduction to Wallace Tree Multiplier.

UNIT – V Lecture Hrs:10

Low-Voltage Low-Power Memories: Basics of ROM, Low-Power ROM Technology, Future Trend and Development of ROMs, Basics of SRAM, Memory Cell, Pre charge and Equalization Circuit, Low-Power SRAM Technologies, Basics of DRAM, Self-Refresh Circuit, Future Trend and Development of DRAM.

Textbooks:

1. CMOS Digital Integrated Circuits–Analysis and Design–Sung-Mo Kang, Yusuf Leblebici, TMH, 2011.
2. Low-Voltage, Low-Power VLSI Subsystems–Kiat-Seng Yeo, Kaushik Roy,TMH Professional Engineering.

Reference Books:

1. Introduction to VLSI Systems: A Logic, Circuit and System Perspective–Ming-BOLin, CRC Press, 2011.
2. Low Power CMOS Design–Anantha Chandrakasan, IEEE Press/Wiley International, 1998.
3. Low Power CMOS VLSI Circuit Design – Kaushik Roy, Sharat C. Prasad, John Wiley & Sons, 2000.

Course Code	IOT AND ITS APPLICATIONS	L	T	P	C
24MVD204b	Program Elective–IV	3	0	0	3
	Semester	II			

Course Objectives:

- To apply the Knowledge in IOT Technologies and Data management.
- To determine the values chains Perspective of M2M to IOT.
- To implement the state of the Architecture of an IOT.
- To compare IOT Applications in Industrial & real world.
- To demonstrate knowledge and understand the security and ethical issues of an IOT.

Course Outcomes(CO): Student will be able to

- Apply the Knowledge in IOT Technologies and Data management.
- Determine the values chains Perspective of M2M to IOT.
- Implement the state of the Architecture of an IOT.
- Compare IOT Applications in Industrial & real world.
- Demonstrate knowledge and understand the security and ethical issues of an IOT.

UNIT-I	Lecture Hrs:10

Fundamentals of IoT: Evolution of Internet of Things, Enabling Technologies, IoT Architectures,oneM2M, IoT World Forum (IoTWF) and Alternative IoT models, Simplified IoT Architecture and Core IoT Functional Stack, Fog, Edge and Cloud in IoT, Functional blocks of an IoT ecosystem, Sensors, Actuators, Smart Objects and Connecting Smart Objects.
IoT Platform overview: Overview of IoT supported Hardware platforms suchas: Raspberry pi, ARM Cortex Processors, Arduino and Intel Galileo boards.

UNIT-II	Lecture Hrs:9

IoT Protocols: IT Access Technologies: Physical and MAC layers, topology and Security of IEEE 802.15.4, 802.15.4g, 802.15.4e, 1901.2a, 802.11ah and Lora WAN, Network Layer: IP versions, Constrained Nodes and Constrained Networks, Optimizing IP for IoT: From 6LoWPAN to 6Lo, Routing over Low Power and Lossy Networks, Application Transport Methods: Supervisory Control And Data Acquisition, Application Layer Protocols: CoAP and MQTT.

UNIT-III	Lecture Hrs:10

Design and Development: Design Methodology, Embedded computing logic, Micro controller, System on Chips, IoT system building blocks, Arduino, Board details, IDE programming, Raspberry Pi, Interfaces and Raspberry Pi with Python Programming.

UNIT-IV	Lecture Hrs:10

Data Analytics and Supporting Services: Structured Vs Unstructured Data and Data in Motion Vs Data in Rest, Role of Machine Learning – No SQL Databases, Hadoop Ecosystem, Apache Kafka, Apache Spark, Edge Streaming Analytics and Network Analytics, Xively Cloud for IoT, Python Web Application Framework, Django, AWS for IoT, System Management with NETCONF-YANG.

UNIT-V	Lecture Hrs:9

Case Studies/Industrial Applications: IoT applications inhome, infrastructures, buildings, security, Industries, Home appliances, other IoT electronic equipments. Use of Big Data and Visualization in IoT, Industry4.0 concepts. Sensors and sensor Node and interfacing using any Embedded target boards (Raspberry Pi/Intel Galileo/ARM Cortex/ Arduino).

Textbooks:

1.IoTFundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, DavidHanes,GonzaloSalgueiro,PatrickGrossetete,RobBartonandJeromeHenry,Cisco Press, 2017.

2.Internet of Things–Ahands-on approach, Arshdeep Bahga,Vijay Madisetti,Universities Press,2015
Reference Books:
1. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012 (for Unit 2). 2. "From Machine-to-Machine to the Internet of Things – Introduction to a New Age of Intelligence", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis, Karnouskos, Stefan Avesand. David Boyle and Elsevier, 2014. 3. Architecting the Internet of Things, Dieter Uckelmann, Mark Harrison, Michahelles and Florian (Eds), Springer, 2011.

Course Code	VLSI SIGNAL PROCESSING	L	T	P	C
24MVD204c	Program Elective– IV	3	0	0	3
	Semester	II			

Course Objectives:

- To study the existing architectures suitable for VLSI.
- To understand the concepts of folding and unfolding algorithms and applications.
- To design new architectures suitable for VLSI.
- To implement fast convolution algorithms.

Course Outcomes(CO): Student will be able to

- Study the existing architectures suitable for VLSI.
- Understand the concepts of folding and unfolding algorithms and applications.
- Design new architectures suitable for VLSI.
- Implement fast convolution algorithms.

UNIT -I	Lecture Hrs:9

Introduction to DSP: Typical DSP algorithms, DSP algorithms benefits, Representation of DSP algorithms Pipelining and Parallel Processing Introduction, Pipelining of FIR Digital filters, Parallel Processing, Pipelining and Parallel Processing for Low Power Retiming Introduction, Definitions and Properties, Solving System of Inequalities, Retiming Techniques.

UNIT - II	Lecture Hrs:10

Folding and Unfolding: Folding- Introduction, Folding Transform, Register minimization Techniques, Register minimization in folded architectures, folding of Multi rate systems Unfolding- Introduction, An Algorithm for Unfolding, Properties of Unfolding, critical Path, Unfolding and Retiming, Applications of Unfolding.

UNIT - III	Lecture Hrs:10

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations contain Delays.

UNIT - IV	Lecture Hrs:9

Fast Convolution: Introduction–Cook-Toom Algorithm–Winogard algorithm–Iterated Convolution–Cyclic Convolution–Design of Fast Convolution algorithm by Inspection.

UNIT - V	Lecture Hrs:10

Low Power Design: Digital lattice filter structures, bit level arithmetic, architecture, redundant arithmetic. Numerical strength reduction, synchronous, wave and asynchronous pipe lines, Scaling Vs Power Consumption, Power Analysis, Power Reduction techniques, Power Estimation Approaches.

Textbooks:

1. Keshab K. Parthi, VLSI Digital Signal Processing-System Design and Implementation, Wiley Inter Science, 1998.
2. Kung S. Y, H.J. While House, T. Kailath, VLSI and Modern Signal processing, Prentice Hall, 1985.

Reference Books

1. Jose E. France, Yannis T sividis, Design of Analog–Digital VLSI Circuits for Telecommunications and Signal Processing , Prentice Hall, 1994.
2. Medisetti V.K, VLSI Digital Signal Processing, IEEE Press(NY),1995

Course Code	CMOS MIXED SIGNAL IC DESIGN LAB	L	T	P	C
24MVD205		0	0	4	2
	Semester	II			

Course Objectives:

- To design and simulate op-amp for given specifications
- To design and simulate data converter for given specifications
- To design and simulate PLL and VCO for given specifications
- To understand the Significance of Pre-Layout Simulation and Post-Layout Simulation.

Course Outcomes(CO):

- Design and simulate op-amp for given specifications
- Design and simulate data converter for given specifications
- Design and simulate PLL and VCO for given specifications
- Understand the Significance of Pre-Layout Simulation and Post-Layout Simulation.

List of Experiments:

The students are required to design and implement the Circuit and Layout of the following Experiments using CMOS 130nm Technology.

Cycle1:

1) Fully compensated op-amp with resistor and miller compensation
2) High speed comparator design
   a. Two stage cross coupled clamped comparator
   b. Strobed Flip-flop
3) Data converter

Cycle2:

1) Switched capacitor circuits
   a. Parasitic sensitive integrator
   b. Parasitic insensitive integrator
2) Design of PLL
3) Design of VCO
4) Band gap reference circuit
5) Layouts of All the circuits Designed and Simulated

Software:

Mentor Graphics/Cadence/Tanner/Industry Equivalent Standard Software Tools

Hardware:

Personal Computer with necessary peripherals, configuration and operating System.

References:

1. David A johns, Ken Martin, Analog Integrated Circuit Design,Wiley, 2008.
2. R.Gregorian and G. C Ternes, Analog MOS Integrated Circuits for Signal Processing, Wiley, 1986.
3. Roubik Gregorian, Introduction to CMOS OpAmpand Comparators, Wiley, 1999.
4. Alan Hastlings, The art of Analog Layout, Wiley, 2005.

Course Code	PHYSICAL DESIGN AUTOMATION LAB	L	T	P	C
24MVD206		0	0	4	2
	Semester	**II**			

Course Objectives:

- To learn the implementation of different Physical Design Automation algorithms
- To implement different graph algorithms
- To implement different partitioning algorithms
- To implement different floor planning algorithms
- To implement different routing algorithms

Course Outcomes(CO):

- Learn the implementation of different Physical Design Automation algorithms
- Implement different graph algorithms
- Implement different partitioning algorithms
- Implement different floor planning algorithms
- Implement different routing algorithms

List of Experiments:

Cycle1:

1) Graph algorithms
   a) Graph search algorithms
      i. Depth first search
      ii. Breadth first search
   b) Spanning tree algorithm
      i. Kruskal's algorithm
   c) Shortest path algorithm
      i. Dijkstra algorithm
      ii. Floyd-Warshall algorithm
   d) Steiner tree algorithm
2) Computational geometry algorithm
   a) Line sweep method
   b) Extended line sweep method

Cycle2:

3) Partitioning algorithms
   a) Group migration algorithms
      I. Kernighan–Lin algorithm
      II. Extensions of Kernighan-Lin algorithm
         i) Fiduccias–Mattheyses algorithm
         ii) Goldberg and Burstein algorithm
   b) Simulated annealing and evolution algorithms
      i. Simulated annealing algorithm
      ii. Simulated evolution algorithm
   III)Metrical location method

4)Floor planning algorithms
   i) Constraint based methods
   ii) Integer programming based methods
   iii) Rectangular dualization based methods
   iv) Hierarchical tree based methods

v) Simulated evolution algorithms
vi) Time driven Floor planning algorithms

5)Routing algorithms
I) Two terminal algorithms
a) Maze routing algorithms
i)Lee‟s algorithm
ii) Soukup‟s algorithm
iii) Hadlock algorithm
b) Line-Probe algorithm
c) Shortest path based algorithm
II) Multi terminal algorithm
a) Stenier tree based algorithm
i) SMST algorithm
ii) Z-RST algorithm

Software required: C/C++ Programming Language/Relevant software

Text Books:

1) Naveed Shervani, Algorithms for Physical Design Automation, 3rd Edition, Kluwer Academic, 1998.
2) Charles J Alpert, Dinesh P Mehta, Sachin S. Sapatnekar, Handbook of Algorithms for Physical Design Automation, CRC Press, 2008.

CourseCode	BICMOSTECHNOLOGYANDAPPLICATIONS	L	T	P	C
24MVD301a	Program Elective– V	3	0	0	3
	Semester	III			

Course Objectives:

- To demonstrate in-depth knowledge in BiCMOS Technology.
- To analyze complex engineering problems critically for conducting research in BiCMOS Technology.
- To solve engineering problems with wide range of solutions in Radio Frequency Integrated circuits.
- To realize different digital circuits using BiCMOS Technology

Course Outcomes(CO): Student will be able to

- Demonstrate in-depth knowledge in BiCMOS Technology.
- Analyze complex engineering problems critically for conducting research in BiCMOS Technology.
- Solve engineering problems with wide range of solutions in Radio Frequency Integrated circuits.
- Realize different digital circuits using BiCMOS Technology

UNIT -I — Lecture Hrs:9

BiCMOS Process Technology: CMOS Process Technology, Bipolar Process Technology, Isolation in CMOS and Bipolar Technologies, BiCMOS Technology, BiCMOS Design Rules.

UNIT - II — Lecture Hrs:10

Device Design Considerations: Design Considerations for MOSFET's, Design Considerations for Bipolar Transistors, BiCMOS Device Design Considerations.
BiCMOS Device Scaling: MOS Device Scaling, Bipolar Device Scaling.

UNIT - III — Lecture Hrs:10

Device Modeling: Modeling of the MOS Transistor: MOSFET Structure and Operation, SPICE Models of the MOS Transistor, Analytical Model for Short-Channel MOS Devices.
Modeling of the Bipolar Transistor: BJT Structure and Operation, Ebers-Moll Model, Bipolar Models in SPICE.

UNIT - IV — Lecture Hrs:9

BiCMOS Digital Integrated Circuits: BiMOS Totem-Pole Inveter: DC Characteristics, Transient Analysis, Delay Dependence on the Device Parameters, BiCMOS Circuit Design, Comparing CMOS and BiCMOS Inverters Speed, BiCMOS Gates.

UNIT - V — Lecture Hrs:10

BiCMOS Digital Circuit Applications: Adders, Multiplier, Random Access Memory, Programmable Logic Arrays, BiCMOS Logic Cells, BiCMOS Gate Arrays.

Textbooks:

1. Sherif H. K. Embabi, AbdellatifBellaouar & MohamedI. Elmasry "Digital BiCMOS Integrated Circuit Design" Springer Science+ BusÎness Media, LLC.
2. ALALVAREZ, BICMOS Technology & Applications, Kluwer Academic Publishers.

Reference Books:

1. Kiat-Sengyeo, Samir S. Rofail, Wang-Ling Goh, CMOS/BiCMOS ULSI, Pearson Education.
2. James C. Daly, Denis P.Galipeau, Analog BiCMOS Design: Practices & Pitfalls, CRC Press
3. Klaas Jande Langen, Johan Huijsing, Compact Low-Voltage and High-Speed CMOS, BiCMOS and Bipolar Operational Amplifiers, Springer Science

Course Code	OPTIMIZATIONTECHNIQUESANDAPPLICATIONS	L	T	P	C
24MVD301b	INVLSIDESIGN (Program Elective– V)	3	0	0	3
	Semester	III			

Course Objectives:

- To understand basics of statistical modeling
- To analyze performance of CMOS circuits with respect to power, area and speed
- To acquire complete knowledge regarding the various algorithms used for optimization of power and area

Course Outcomes(CO): Student will be able to

- Understand basics of statistical modeling
- Analyze performance of CMOS circuits with respect to power, area and speed
- Acquire complete knowledge regarding the various algorithms used for optimization of power and area

UNIT -I	Lecture Hrs:10

Statistical Modeling: Modeling sources of variations, Monte Carlo techniques, Process variation modeling-Pelgrom's model, Principle component based modeling, Quad tree based modeling, Performance modeling-Response surface methodology, delay modeling, interconnect delay models.

UNIT - II	Lecture Hrs:9

Statistical Performance, Power and Yield Analysis: Statistical timing analysis, parameter space techniques, Bayesian networks Leakage models, High level statistical analysis, Gate level statistical analysis, dynamic power, leakage power, temperature and power supply variations, High level yield estimation and gate level yield estimation.

UNIT - III	Lecture Hrs:10

Convex Optimization: Convex sets, convex functions, geometric programming, trade-off and sensitivity analysis, Generalized geometric programming, geometric programming applied to digital circuit gate sizing, Floor planning, wire sizing, Approximation and fitting-Monomial fitting, Maxmonomial fitting, Polynomial fitting.

UNIT - IV	Lecture Hrs:10

Genetic Algorithm: Introduction, GA Technology-Steady State Algorithm-Fitness Scaling-Inversion GA for VLSI Design, Layout and Test automation- partitioning-automatic placement, routing technology, mapping for FPGA-Automatic test generation-Partitioning algorithm Taxonomy-Multi-way Partitioning Hybrid genetic-encoding-local improvement-WDFR Comparison of CAS-Standard cell placement GASP algorithm-unified algorithm.

UNIT - V	Lecture Hrs:9

GA Routing Procedures and Power Estimation: Global routing-FPGA technology mapping-circuit generation-test generation in a GA frame work-test generation procedures, Power estimation-application of GA Standard cell placement–GA for ATG-problem encoding-fitness function-GA Vs Conventional algorithm.

Textbooks:

1. Statistical Analysis and Optimization for VLSI: Timing and Power–Ashish Srivastava, Dennis Sylvester, David Blaauw, Springer, 2005.
2. Genetic Algorithm for VLSI Design, Layout and Test Automation –Pinaki Mazumder, E.Mrudnick, Prentice Hall,1998.

Reference Books:

1. Convex Optimization-Stephen Boyd, LievenVandenberghe ,Cambridge University Press, 2004

Course Code	SoC ARCHITECTURE	L	T	P	C
24MVD203a	Program Elective– V	3	0	0	3
	Semester	III			

Course Objectives:

- To understand the basics related to SoC architecture and different approaches related to SoC Design.
- To select an appropriate robust processor for SoC Design
- To select an appropriate memory for SoC Design.
- To realize real time case studies

Course Outcomes(CO): Student will be able to

- Understand the basics related to SoC architecture and different approaches related to SoC Design.
- Select an appropriated robust processor for SoC Design
- Select an appropriate memory for SoC Design.
- Realize real time case studies

UNIT -I — Lecture Hrs:10

Introduction to the System Approach: System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory &Addressing. System level interconnection, An approach for SOC Design, System Architecture and Complexity.

UNIT - II — Lecture Hrs:9

Processors: Introduction, Processor Selection for SOC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro architecture, Basic elements in Instruction handling. Buffers: minimizing PipelineDelays,Branches,MoreRobustProcessors,VectorProcessorsand Vector Instruction extensions, VLIW Processors, Super scalar Processors.

UNIT - III — Lecture Hrs:10

Memory Design for SOC: Overview: SOC external memory, SOC Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Other Types of Cache, Split– I, and D – Caches, Multilevel Caches, SOC Memory System, Models of Simple Processor–memory interaction.

UNIT - IV — Lecture Hrs:10

Interconnect, Customization and Configurability: Interconnect Architectures, Bus: Basic Architectures, SOC Standard Buses , Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time.

SOC Customization: An overview, Customizing Instruction Processor, Reconfigurable Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration-over head analysis and trade-off analysis on reconfigurable Parallelism.

UNIT - V — Lecture Hrs:9

Application Studies/Case Studies: SOC Design approach; AES-algorithms, Design and evaluation; Image compression–JPEG compression.

Textbooks:

1. Computer System Design System-on-Chip - Michael J. Flynn and Wayne Luk, Wiely India Pvt.Ltd.
2. ARM System on Chip Architecture–Steve Furber, 2nd Edition, 2000, Addison Wesley Professional.

Reference Books:

1. Design of System on a Chip: Devices and Components–Ricardo Reis,1stEd., 2004, Springer
2. Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology) – Jason Andrews – Newnes, BK and CDROM.
System on Chip Verification – Methodologies and Techniques –Prakash Rashinkar, Peter Paterson and Leena Singh L, 2001, Kluwer Academic Publishers.

AUDIT COURSE-I

Course Code	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
24MAC101a		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Understand the essentials of writing skills and their level of readability
- Learn about what to write in each section
- Ensure qualitative presentation with linguistic accuracy

Course Outcomes(CO): Student will be able to

- Understand the significance of writing skills and the level of readability
- Analyze and write title, abstract, different sections in research paper
- Develop the skills needed while writing are search paper

UNIT -I		Lecture Hrs:10

1Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking upLongSentences-StructuringParagraphsandSentences-BeingConciseandRemovingRedundancy -Avoiding Ambiguity.

UNIT - II		Lecture Hrs:10

Essential Components of a Research Paper-Abstracts-Building Hypothesis-Research Problem-Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Cauterization.

UNIT - III		Lecture Hrs:10

Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion-Conclusions-Recommendations.

UNIT - IV		Lecture Hrs:9

Key skills needed for writing a Title, Abstract, and Introduction

UNIT - V		Lecture Hrs:9

Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions.

Suggested Reading

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Code	DISASTER MANAGEMENT	L	T	P	C
24MAC101b		2	0	0	0
	Semester	I			

Course Objectives: This course will enable students:

- Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they workin.

UNIT -I

Introduction: Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Disaster Prone Areas in India:

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics.

UNIT – II

Repercussions of Disasters and Hazards:

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches. Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT – III

Disaster Preparedness and Management:

Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT – IV

Risk Assessment Disaster Risk:

Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT – V

Disaster Mitigation:

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Suggested Reading

1. R.Nishith,SinghAK,"DisasterManagementinIndia:Perspectives,issuesandstrategies
2. "'NewRoyalbook Company..Sahni,PardeepEt.Al.(Eds.)," DisasterMitigationExperiencesAndReflections",PrenticeHall OfIndia, New Delhi.
3. 3.GoelS.L.,DisasterAdministrationAndManagementTextAndCaseStudies",Deep&Deep Publication Pvt. Ltd., New Delhi

Course Code	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
24MAC101c		2	0	0	0
	Semester	**I**			

Course Objectives: This course will enable students:

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- The engineering scholars equipped with Sanskrit will be able to explore the huge
- Knowledge from ancient literature

Course Outcomes(CO): Student will be able to

- Understanding basic Sanskrit language
- Ancient Sanskrit literature about science & technology can be understood
- Being a logical language will help to develop logic in students

UNIT -I

Alphabets in Sanskrit,

UNIT - II

Past/Present/Future Tense, Simple Sentences

UNIT - III

Order, Introduction of roots

UNIT - IV

Technical information about Sanskrit Literature

UNIT - V

Technical conceptsofEngineering-Electrical,Mechanical,Architecture,Mathematics

Suggested Reading

1.“Abhyaspustakam”–Dr.Vishwas, Sanskrit-Bharti Publication, New Delhi
2.“Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3.“India’s Glorious Scientific Tradition” Suresh Soni, Ocean books(P) Ltd., New Delhi

AUDIT COURSE-II

Course Code	PEDAGOGY STUDIES	L	T	P	C
21DAC201a		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- Review existing evidence on there view topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Course Outcomes(CO): Student will be able to

Students will be able to understand:

- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT -I — Lecture Hrs:9

Introduction and Methodology: Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum, Teacher education. Conceptual frame work, Research questions**.** Overview of methodology and Searching.

UNIT - II — Lecture Hrs:10

Thematic over view: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

UNIT - III — Lecture Hrs:9

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT - IV — Lecture Hrs:10

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

UNIT – V — Lecture Hrs:10

Research gaps and future directions: Research design**,** Contexts**,** Pedagogy**,** Teacher education**,** Curriculum and assessment**,** Dissemination and research impact.

Suggested Reading

1. AckersJ, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of
3. Curriculum Studies, 36(3):361-379.

4. Akyeampong K (2003) Teacher training in Ghana-does it count ? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
5. Akyeampong K, Lussier K, PryorJ, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
6. Alexander R J (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
   Chavan M (2003) ReadIndia: Amassscale, rapid,'learningtoread' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Code	STRESS MANAGEMENT BY YOGA	L	T	P	C
24MAC201b		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To achieve overall health of body and mind
- To overcome stress

Course Outcomes(CO): Student will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT –I		Lecture Hrs:10
Definitions of Eight parts of yog.(Ashtanga)		
UNIT – II		Lecture Hrs:9
Yam and Niyam.		
UNIT – III		Lecture Hrs:10
Do`s and Don't's in life. i) Ahinsa, satya, astheya, bramhacharya and aparigrahaii) Shaucha, santosh, tapa, swadhyay, is hwarpranidhan		
UNIT – IV		Lecture Hrs:10
Asan and Pranayam		
UNIT – V		Lecture Hrs:9
i)Various yogposes and their benefits for mind &body ii)Regularization of breathing techniques and its effects-Types of pranayam		

Suggested Reading

1.'Yogic Asanas for Group Tarining-Part-I": Janardan Swami Yogabhyasi Mandal, Nagpur 2."RajayogaorconqueringtheInternalNature"bySwamiVivekananda,Advaita Ashrama (Publication Department), Kolkata

Course Code	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
24MAC201c		2	0	0	0
	Semester	**II**			

Course Objectives: This course will enable students:

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Course Outcomes(CO): Student will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students

UNIT-I — Lecture Hrs:9

Neetisatakam-Holistic development of personality

Verses-19, 20, 21, 22 (wisdom)

Verses-29, 31, 32 (pride & heroism)

Verses-26, 28, 63, 65 (virtue)

UNIT - II — Lecture Hrs:10

Neetisatakam-Holistic development of personality

Verses-52, 53, 59 (dont's)

Verses-71, 73, 75, 78 (do's)

UNIT – III — Lecture Hrs:9

Approach to day to day work and duties.

Shrimad Bhagwad Geeta:Chapter2-Verses 41,47,48,

Chapter3-Verses 13, 21, 27, 35,

Chapter6-Verses 5,13,17,23,35,

Chapter18-Verses45, 46, 48.

UNIT – IV — Lecture Hrs:10

Statements of basic knowledge.

Shrimad Bhagwad Geeta:Chapter2-Verses 56,62,68

Chapter12 -Verses13,14,15,16,17,18

Personality of Role model. Shrimad Bhagwad Geeta:

UNIT – V — Lecture Hrs:10

Chapter2-Verses 17,Chapter3-Verses36,37,42,

Chapter4-Verses18,38,39

Chapter18–Verses37,38,63

Suggested Reading

1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

OPEN ELECTIVE

Course Code	INDUSTRIAL SAFETY	L	T	P	C
24MOE301b		3	0	0	3
Semester		III			

Course Objectives:

- To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models
- To understand about fire and explosion, preventive methods, relief and its sizing methods
- To analyse industrial hazard sand its risk assessment.

Course Outcomes(CO): Student will be able to

- To list out important legislations related to health, Safety and Environment.
- To list out requirements mentioned in factories act for the prevention of accidents.
- To understand the health and welfare provisions given in factories act.

UNIT -I — Lecture Hrs:9

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and fire fighting, equipment and methods.

UNIT - II — Lecture Hrs:10

Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT - III — Lecture Hrs:10

Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT - IV — Lecture Hrs:10

Fault tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT - V — Lecture Hrs:9

Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machinetools,ii.Pumps,iii.Aircompressors,iv.Dieselgenerating(DG)sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

Textbooks:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H.P. Garg, S. Chandand Company.

Reference Books:

1. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
2. Foundation Engineering Handbook,Winterkorn,Hans,Chapman&HallLondon.

Course Code	BUSINESS ANALYTICS	L	T	P	C
24MOE301c		3	0	0	3
Semester		III			

Course Objectives:

- The main objective of this course is to give the student a comprehensive understanding of business analytics methods.

Course Outcomes(CO): Student will be able to

- Students will demonstrate knowledge of data analytics.
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
- Students will demonstrate the ability to translate data into clear, actionable insights.

UNIT -I — Lecture Hrs:9

Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst.
Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.

UNIT - II — Lecture Hrs:10

Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.

UNIT - III — Lecture Hrs:10

Forming Requirements: Overview of Requirements Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents. Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/SubtractiveAnalysis,GapAnalysis,Notations(UML&BPMN),Flowcharts,SwimLane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling.

UNIT - IV — Lecture Hrs:9

Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools.

UNIT - V — Lecture Hrs:10

Recent Trands in: Embedded and collaborative business intelligence, Visual data recovery, Data Story telling and Data Journalism.

Textbooks:

1. Business Analysis by James Cadleetal.
2. Project Management: The Managerial Process by Erik Larsonand, Clifford Gray

Reference Books:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Course Code	WASTE TO ENERGY	L	T	P	C
24MOE301e		3	0	0	3
	Semester	**III**			

Course Objectives:

- Introduce and explain energy from waste, classification and devices to convert waste to energy.
- To impart knowledge on biomass pyrolysis, gasification, combustion and conversion process.
- To educate on biogas properties , bio energy system, biomass resources and their classification and biomass energy programme in India.

Course Outcomes(CO): Student will be able to

- To know about overview of Energy to waste and classification of waste.
- To acquire knowledge on bio mass pyrolysis, gasification, combustion and conversion process in detail.
- To gain knowledge on properties of biogas, biomass resources and programmes to convert waste to energy in India.

UNIT -I	Lecture Hrs:10

Introduction to Energy from Waste: Classification of waste as fuel–Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT - II	Lecture Hrs:10

Biomass Pyrolysis: Pyrolysis–Types, slowfast–Manufacture of charcoal–Methods-Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT - III	Lecture Hrs:12

Biomass Gasification: Gasifiers–Fixed bed system–Downdraft and updraft gasifiers–Fluidized bed gasifiers–Design, construction and operation–Gasifier burner arrangement for thermal heating –Gasifier engine arrangement and electrical power–Equilibrium and kinetic consideration in gasifier operation

UNIT - IV	Lecture Hrs:12

Biomass Combustion: Biomass stoves–Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT - V	LectureHrs:10

Biogas: Properties of biogas (Calorific value and composition)-Bio gas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification- pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogasPlants–Applications-Alcoholproductionfrombiomass-Biodieselproduction-
Urban waste to energy conversion- Biomass energy programme in India.

Textbooks:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 2018
2. Biogas Technology-A Practical Hand Book-Khandelwal, K.C. and Mahdi,S.S., TMH, 2017

Reference Books:

1. Food, Feedand Fuel from Biomass, Challal, D.S., IBH Publishing Co. Pvt.Ltd., 1991.
2. Biomass Conversion and Technology, C.Y. WereKo-Brobby and E.B.Hagan, John Wiley &Sons,1996

OnlineLearningResources:

https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ch13/https://www.youtube.com/watch?v=x2KmjbCvKTk