

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. IN VLSI /VLSI DESIGN/ VLSI SYSTEM DESIGN**  
**EFFECTIVE FROM ACADEMIC YEAR 2022-23 ADMITTED BATCH**

**R22 COURSE STRUCTURE AND SYLLABUS**

**I YEAR I – SEMESTER**

Course Code	Course Title	L	T	P	Credits
Professional Core - I	Digital System Design with FPGAs	3	0	0	3
Professional Core - II	CMOS Analog IC Design	3	0	0	3
Professional Elective - I	1. Pattern Recognition and Machine Learning 2. CMOS Mixed Signal Design 3. Memory Technologies	3	0	0	3
Professional Elective - II	1. Communication Buses & Interfaces 2. ARM Microcontrollers 3. Embedded Real Time Operating System	3	0	0	3
Lab - I	Digital System Design with FPGAs Lab	0	0	4	2
Lab - II	CMOS Analog IC Design Lab	0	0	4	2
	Research Methodology & IPR	2	0	0	2
Audit - I	Audit Course – I	2	0	0	0
	<b>Total Credits</b>	<b>16</b>	<b>0</b>	<b>8</b>	<b>18</b>

**I YEAR II – SEMESTER**

Course Code	Course Title	L	T	P	Credits
Professional Core - III	VLSI Advanced Physical Design	3	0	0	3
Professional Core - IV	System Verilog Test Benches using UVM	3	0	0	3
Professional Elective - III	1. IoT Architectures and System Design 2. SoC Design 3. Design for Testability	3	0	0	3
Professional Elective - IV	1. Device Modeling 2. RF IC Design 3. Hardware and Software Co-Design	3	0	0	3
Lab - III	VLSI Advanced Physical Design Lab	0	0	4	2
Lab - IV	System Verilog Test Benches using UVM Lab	0	0	4	2
	Mini Project with Seminar	0	0	4	2
Audit - II	Audit Course- II	2	0	0	0
	<b>Total Credits</b>	<b>14</b>	<b>0</b>	<b>12</b>	<b>18</b>

**II YEAR I – SEMESTER**

Course Code	Course Title	L	T	P	Credits
Professional Elective - V	1. Advanced Computer Architecture 2. Nanomaterials & Nanotechnology 3. Hardware Security	3	0	0	3
Open Elective	Open Elective	3	0	0	3
Dissertation	Dissertation Work Review – II	0	0	12	6
	<b>Total Credits</b>	<b>6</b>	<b>0</b>	<b>12</b>	<b>12</b>

**II YEAR II - SEMESTER**

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
Dissertation	Dissertation Work Review - III	0	0	12	06
Dissertation	Dissertation Viva-Voce	0	0	28	14
	<b>Total</b>	<b>0</b>	<b>0</b>	<b>40</b>	<b>20</b>

**Open Electives:**

1. Business Analytics
2. Industrial Safety
3. Operations Research
4. Cost Management of Engineering Projects
5. Composite Materials

**Audit Course I & II:**

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development Through Life Enlightenment Skills

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- I YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**DIGITAL SYSTEM DESIGN WITH FPGAs (PC – I)**

**Pre-Requisite:** Switching Theory and Logic Design

**Course Objectives:**

1. To provide extended knowledge of digital logic circuits in the form of state model approach.
2. To provide an overview of system design approach using programmable logic devices.
3. To provide and understand of fault models and test methods.
4. To get exposed to the various architectural features of CPLDS and FPGAS.
5. To learn the methods and techniques of CPLD & FPGA design with EDA tools.
6. To expose software tools used for design process with the help of case studies.

**Course Outcomes:**

1. To exposes the design approaches using FPGAs.
2. To provide in depth understanding of Fault models.
3. To understands test pattern generation techniques for fault detection.
4. To design fault diagnosis in sequential circuits.
5. To provide understanding in the design of flow using case studies.

**UNIT- I**

**Programmable Logic Devices:** The concept of programmable Logic Devices, SPLDs, PAL devices, PLA devices, GAL devices, CPLD-Architecture, FPGAs-FPGA technology, architecture, virtex CLB and slice, FPGA Programming Technologies, Xilinx XC2000, XC3000, XC4000 Architectures, Actel ACT1, ACT2 and ACT3 Architectures. [TEXTBOOK-1]

**UNIT- II**

**Analysis and derivation of clocked sequential circuits with state graphs and tables:** A sequential parity checker, Analysis by signal tracing and timing charts-state tables and graphs-general models for sequential circuits, Design of a sequence detector, More Complex design problems, Guidelines for construction of state graphs, serial data conversion, Alphanumeric state graph notation. Need and Design strategies for multi-clock sequential circuits. [TEXTBOOK-2]

**UNIT- III**

**Sequential circuit Design:** Design procedure for sequential circuits-design example, Code converter, Design of Iterative circuits, Design of a comparator, Controller (FSM) – Metastability, Synchronization, FSM Issues, Pipelining resources sharing, Sequential circuit design using FPGAs, Simulation and testing of Sequential circuits, Overview of computer Aided Design. [TEXTBOOK-2]

**UNIT- IV**

**Fault Modeling and Test Pattern Generation:** Logic Fault Model, Fault detection & redundancy, Fault equivalence and fault location, Fault dominance, Single stuck at fault model, multiple Stuck at Fault models, Bridging Fault model.

Fault diagnosis of combinational circuits by conventional methods, path sensitization techniques, Boolean difference method, KOHAVI algorithm, Test algorithms-D algorithm, Random testing, transition count testing, signature analysis and test bridging faults. [TEXTBOOK-3 & Ref.1]

**UNIT - V**

**Fault Diagnosis in sequential circuits:** Circuit Test Approach, Transition check Approach, State identification and fault detection experiment, Machine identification, Design of fault detection experiment. [Ref.3]

**TEXT BOOKS:**

1. Digital Electronics and design with VHDL- Volnei A. Pedroni, Elsevier publications.
2. Fundamentals of Logic Design-Charles H.Roth,Jr. -5<sup>th</sup>Ed.,Cengage Learning.
3. Digital Circuits and Logic Design-Samuel C.LEE,PHI, 2008.

**REFERENCE BOOKS:**

1. Logic Design Theory- N.N.Biswas, PHI.
2. Digital System Design using programmable logic devices- Parag K.Lala, BS publications.
3. Switching and Finite Automata Theory - Zvi Kohavi & Niraj K. Jha, 3<sup>rd</sup> Edition, Cambridge, 2010.

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**M.TECH. - I YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**CMOS ANALOG IC DESIGN (PC - II)**

**Pre-requisite:** Analog Electronics

**Course Objectives:** Analog circuits play a very crucial role in all electronic systems and due to continued miniaturization, many of the analog blocks are not getting realized in CMOS technology.

1. To understand most important building blocks of all CMOS analog ICs.
2. To study the basic principle of operation, the circuit choices and the tradeoffs involved in the MOS transistor level design common to all analog CMOS ICs.
3. To understand specific design issues related to single and multistage voltage, current and differential amplifiers, their output and impedance issues, bandwidth, feedback and stability.
4. To understand the design of differential amplifiers, current amplifiers and OP AMPs.

**Course Outcomes:** After studying the course, each student is expected to be able to

1. Design basic building blocks of CMOS analog ICs.
2. Carry out the design of single and two stage operational amplifiers and voltage references.
3. Determine the device dimensions of each MOSFETs involved.
4. Design various amplifiers like differential, current and operational amplifiers.

#### **UNIT - I**

##### **MOS Devices and Modeling**

The MOS Transistor, Passive Components- Capacitor & Resistor, Integrated circuit Layout, CMOS Device Modeling - Simple MOS Large-Signal Model, Other Model Parameters, Small-Signal Model for the MOS Transistor, Computer Simulation Models, Sub-threshold MOS Model.

#### **UNIT- II**

##### **Analog CMOS Sub-Circuits**

MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors- Current mirror with Beta Helper, Degeneration, Cascode current Mirror and Wilson Current Mirror, Current and Voltage References, Band gap Reference.

#### **UNIT – III**

##### **CMOS Amplifiers**

Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures.

#### **UNIT - IV**

##### **CMOS Operational Amplifiers**

Design of CMOS Op Amps, Compensation of Op Amps, Design of Two-Stage Op Amps, Power-Supply Rejection Ratio of Two-Stage Op Amps, Cascode Op Amps, Measurement Techniques of OP Amp.

#### **UNIT - V**

##### **Comparators**

Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.

**TEXT BOOKS:**

1. CMOS Analog Circuit Design - Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition, 2010.
2. Analysis and Design of Analog Integrated Circuits- Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, Wiley India, Fifth Edition, 2010.

**REFERENCE BOOKS:**

1. Analog Integrated Circuit Design- David A. Johns, Ken Martin, Wiley Student Edn, 2013.
2. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition.
3. CMOS: Circuit Design, Layout and Simulation- Baker, Li and Boyce, PHI.

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**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**PATTERN RECOGNITION AND MACHINE LEARNING (PE – I)**

**Prerequisite:** Statistics and Linear Algebra

**Course Objectives:**

1. The student will be able to understand the mathematical formulation of patterns.
2. To study the various linear models.
3. Understand the basic classifiers.
4. Can able to distinguish different models.

**Course Outcomes:** On completion of this course student will be able to

1. Familiar the basics of pattern classes and functionality.
2. Construct the various linear models.
3. Use the different kernel methods.
4. Design the Markov and Mixed models.

**UNIT-I**

**Introduction to Pattern recognition:** Mathematical Formulation and Basic Functional Equation, Reduction of Dimensionality, Experiments in Pattern Classification, Backward Procedure for Both Feature Ordering- and Pattern Classification, Suboptimal Sequential Pattern Recognition, Nonparametric Design of Sequential Pattern Classifiers, Analysis of Optimal Performance and a Multiclass Generalization

**UNIT-II**

**Linear Models:** Linear Basis Function Models -Maximum likelihood and least squares, Geometry of least squares , Sequential learning, Regularized least squares, Multiple outputs , The Bias-Variance Decomposition, Bayesian Linear Regression -Parameter distribution, Predictive, Equivalent, Bayesian Model Comparison, Probabilistic Generative Models-Continuous inputs, Maximum likelihood solution, Discrete features, Exponential family, Probabilistic Discriminative Models -Fixed basis functions, Logistic regression, Iterative reweighted least squares, Multiclass logistic regression, Probit regression, Canonical link functions

**UNIT-III**

**Kernel Methods:** Constructing Kernels, Radial Basis Function Networks - Nadaraya-Watson model, Gaussian Processes -Linear regression revisited, Gaussian processes for regression, Learning the hyper parameters, Automatic relevance determination, Gaussian processes for classification, Laplace approximation, Connection to neural networks, Sparse Kernel Machines- Maximum Margin Classifiers, Overlapping class distributions, Relation to logistic regression, Multiclass SVMs, SVMs for regression, Computational learning theory, Relevance Vector Machines- RVM for regression, Analysis of sparsity, RVM for classification

**UNIT-IV**

**Graphical Models:** Bayesian Networks, Example: Polynomial regression, Generative models, Discrete variables, Linear-Gaussian models, Conditional Independence- Three example graphs, D-separation, Markov Random Fields -Conditional independence properties, Factorization properties, Illustration: Image de-noising, Relation to directed graphs, Inference in Graphical Models- Inference on a chain, Trees, Factor graphs, The sum-product algorithm, The max-sum algorithm, Exact inference in general graphs, Loopy belief propagation, Learning the graph structure.

**UNIT-V**

**Mixture Models and EM algorithm:** K-means Clustering-Image segmentation and compression, Mixtures of Gaussians-Maximum likelihood, EM for Gaussian mixtures, An Alternative View of EM-Gaussian mixtures revisited, Relation to K-means, Mixtures of Bernoulli distributions, EM for Bayesian linear regression, The EM Algorithm in General, Combining Models- Tree-based Models, Conditional Mixture Models- Mixtures of linear regression models, Mixtures of logistic models, Mixtures of experts.

**TEXT BOOKS:**

1. Sequential methods in Pattern Recognition and Machine Learning-K.S.Fu, Academic Press, volume no.52.
2. Pattern Recognition and Machine Learning- C. Bishop-Springer,2006.

**REFERENCE BOOKS:**

1. Pattern Classification- Richard o. Duda, Peter E. hart, David G. Stork, John Wiley& Sons, 2<sup>nd</sup> Ed., 2001.
2. The elements of Statistical Learning- Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, Springer, 2<sup>nd</sup> Ed., 2009.



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**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**CMOS MIXED SIGNAL DESIGN (PE-I)**

**Pre-Requisites:** Analog Electronics

**Course Objectives:** The objectives of this course are to

1. Introduce circuit design concepts for basic building blocks used in mixed-signal integrated circuit designs.
2. Provide students with the skills to design mixed-signal integrated circuits with these building blocks.
3. Understand design and operation of basic analog circuits.
4. Know mixed signal circuits like DAC, ADC, PLL etc.
5. Design and analysis of switched capacitor circuits
6. Analysis basic data conversion algorithms and circuits.

**Course Outcomes:** After completing this course, each student will have demonstrated proficiency in:

1. Designing CMOS analog circuits to achieve performance specifications.
2. Analyzing CMOS based switched capacitor circuits.
3. Designing data converters and know how to use these in specific applications
4. Design a mixed-signal circuits with understanding design flow.

#### **UNIT- I**

##### **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, biquad filters.

#### **UNIT- II**

##### **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**

##### **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**

##### **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, Time-interleaved converters.

#### **UNIT - V**

##### **Oversampling Converters**

Noise shaping modulators, Decimating filters and interpolating filters, Higher order modulators, Delta sigma modulators with multibit quantizers, Delta sigma D/A.

#### **TEXT BOOKS**

1. Design of Analog CMOS Integrated Circuits- Behzad Razavi, TMH Edition, 2002.

2. CMOS Analog Circuit Design - Philip E. Allen and 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. Jacob Baker, Wiley Interscience, 2009.

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**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**MEMORY TECHNOLOGIES (PE – 1)**

**Course Objectives:**

1. To know the RAM technologies, architecture and applications
2. To know the circuit design concepts of Non-volatile memories
3. To understand the Memory package density technologies.

**Course Outcomes:** At the end of the course, students will be able to:

1. Select architecture and design semiconductor memory circuits and subsystems.
2. Identify various fault models, modes and mechanisms in semiconductor memories and their testing procedures.
3. Know, how of the state-of-the-art memory chip design

**UNIT- I**

Random Access Memory Technologies: Static Random-Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs.

**UNIT- II**

DRAMs, MOS DRAM Cell, BiCMOS DRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs, SRAM and DRAM Memory controllers.

**UNIT- III**

Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories.

**UNIT- IV**

Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random-Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random-Access Memories (MRAMs), Experimental Memory Devices.

**UNIT- V**

Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging.

**TEXT BOOKS:**

1. Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience
2. Kiyoo Itoh, "VLSI memory chip design", Springer International Ed.

**REFERENCE BOOKS:**

1. Ashok K Sharma, "Semiconductor Memories: Technology, Testing and Reliability, PHI

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**COMMUNICATION BUSES AND INTERFACES (PE – II)**

**Course Objectives:**

1. To know how to select the suitable Buses for different applications
2. To know the architecture of CAN and applications
3. To understand the use of PCIe, USB etc.,
4. To know the serial communication protocol

**Course Outcomes:** At the end of the course, students will be able to:

1. Select a particular serial bus suitable for a particular application.
2. Develop APIs for configuration, reading and writing data onto serial bus.
3. Design and develop peripherals that can be interfaced to desired serial bus.

**UNIT - I**

Serial Busses - Physical interface, Data and Control signals, features, limitations and applications of RS232, RS485, I2C, SPI

**UNIT - II**

CAN - Architecture, Data transmission, Layers, Frame formats, applications

**UNIT - III**

PCIe - Revisions, Configuration space, Hardware protocols, applications

**UNIT - IV**

USB - Transfer types, enumeration, Descriptor types and contents, Device driver

**UNIT - V**

Data Streaming Serial Communication Protocol - Serial Front Panel Data Port (SFPDP) using fiber optic and copper cable

**TEXT BOOKS:**

1. Jan Axelson, "Serial Port Complete - COM Ports, USB Virtual Com Ports, and Ports for Embedded Systems", Lakeview Research, 2<sup>nd</sup> Edition
2. Jan Axelson, "USB Complete", Penram Publications
3. Mike Jackson, Ravi Budruk, "PCI Express Technology", Mindshare Press
4. Wilfried Voss, "A Comprehensive Guide to Controller Area Network", Copperhill Media Corporation, 2<sup>nd</sup> Edition, 2005.
5. Serial Front Panel Draft Standard VITA 17.1 –200x
6. Technical references on [www.can-cia.org](http://www.can-cia.org), <http://www.pcisig.com>, <http://www.usb.org>

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**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**ARM MICROCONTROLLERS (PE - II)**

**Course Objectives:**

1. Explore the architecture and instruction set of ARM processor.
2. To provide a comprehensive understanding of various programs of ARM Processors.
3. Learn the programming on ARM Cortex M.

**Course Outcomes:** After completing this course the student will be able to:

1. Explore the selection criteria of ARM processors by understanding the functional level trade off issues.
2. Explore the ARM development towards the functional capabilities.
3. Work with ASM level program using the instruction set.
4. Programming the ARM Cortex M.

**UNIT - I**

**ARM Embedded Systems:** RISC design philosophy, ARM design philosophy, Embedded system hardware, Embedded system software.

**ARM Processor Fundamentals:** Registers, Current Program Status Register, Pipeline, Exceptions Interrupts and Vector Table, Core Extensions, Architecture Revisions, ARM Processor Families.

**Architecture of ARM Processors:** Introduction to the architecture, Programmer's model- operation modes and states, registers, special registers, floating point registers, Behaviour of the application program status register(APSR)-Integer status flags, Q status flag, GE bits, Memory system-Memory system features, memory map, stack memory, memory protection unit (MPU), Exceptions and Interrupts-what are exceptions?, nested vectored interrupt controller(NVIC), vector table, Fault handling, System control block (SCB), Debug, Reset and reset sequence.

**UNIT - II**

**Introduction to the Arm Instruction Set:** Data processing instructions, branch instructions, load-store instructions, software interrupt instructions, program status register instructions, loading constants, ARMv5E extensions, Conditional execution.

**Introduction to the Thumb Instruction Set:** Thumb Register Usage, ARM-Thumb Interworking, Other Branch Instructions, Data Processing Instructions, Single-Register Load-Store Instructions, Multiple-Register Load-Store Instructions, Stack Instructions, Software Interrupt Instruction.

**UNIT - III**

**Technical Details of ARM Cortex M Processors** General information about Cortex-M3 and cortex M4 processors-Processor type, processor architecture, instruction set, block diagram, memory system, interrupt and exception support, Features of the cortex-M3 and Cortex-M4 Processors-Performance, code density, low power, memory system, memory protection unit, interrupt handling, OS support and system level features, Cortex-M4 specific features, Ease of use, Debug support, Scalability, Compatibility.

**UNIT - IV**

**Instruction SET of ARM Cortex M** Background to the instruction set in ARM Cortex-M Processors, Comparison of the instruction set in ARM Cortex-M Processors, understanding the assembly language syntax, Use of a suffix in instructions, Unified assembly Language (UAL), Instruction set, Cortex-M4-specific instructions, Barrel shifter, Accessing special instructions and special registers in Programming.

**UNIT - V**

**Floating Point Operations** About Floating Point Data, Cortex-M4 Floating Point Unit (FPU)- overview, FP registers overview, CPACR register, Floating point register bank, FPSCR, FPU->FPCCR, FPU->FPCAR, FPU->FPDSCR, FPU->MVFR0, FPU->MVFR1. ARM Cortex-M4 and DSP Applications: DSP on a microcontroller, Dot Product example, writing optimized DSP code for the CortexM4-Biquad filter, Fast Fourier transform, FIR filter.

**TEXT BOOKS:**

1. ARM System Developer's Guide Designing and Optimizing System Software by Andrew N. SLOSS, Dominic SYMES, Chris WRIGHT, Elsevier Publications, 2004.
2. The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors by Joseph Yiu, Elsevier Publications, 3<sup>rd</sup> Ed.,

**REFERENCE BOOKS:**

1. Arm System on Chip Architectures – Steve Furber, Edison Wesley, 2000.
2. ARM Architecture Reference Manual – David Seal, Edison Wesley, 2000.

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**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**EMBEDDED REAL TIME OPERATING SYSTEMS (PE – II)**

**Prerequisite:** Computer Organization and Operating System

**Course Objectives:** The objectives of this course are:

1. To provide broad understanding of the requirements of Real Time Operating Systems.
2. To make the student understand, applications of these Real Time features using case studies.

**Course Outcomes:** Students will:

1. Be able to explain real-time concepts such as preemptive multitasking, task priorities, priority inversions, mutual exclusion, context switching, and synchronization, interrupt latency and response time, and semaphores.
2. Able describe how a real-time operating system kernel is implemented.
3. Explain how the real-time operating system implements time management.
4. Be able to work with real time operating systems like RT Linux, Vx Works, MicroC /OS-II, Tiny OS

#### **UNIT - I**

**Introduction:** Introduction to UNIX/LINUX, Overview of Commands, File I/O, (open, create, close, lseek, read, write), Process Control (fork, vfork, exit, wait, waitpid, exec).

#### **UNIT - II**

**Real Time Operating Systems:** Brief History of OS, Defining RTOS, The Scheduler, Objects, Services, Characteristics of RTOS, Defining a Task, asks States and Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency.

Defining Semaphores, Operations and Use, Defining Message Queue, States, Content, Storage, Operations and Use.

#### **UNIT - III**

**Objects, Services and I/O:** Pipes, Event Registers, Signals, Other Building Blocks, Component Configuration, Basic I/O Concepts, I/O Subsystem.

#### **UNIT - IV**

**Exceptions, Interrupts and Timers:** Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time Clocks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers, Operations.

#### **UNIT - V**

**Case Studies of RTOS:** RT Linux, MicroC/OS-II, Vx Works, Embedded Linux, and Tiny OS.

#### **TEXT BOOK:**

1. Real Time Concepts for Embedded Systems – Qing Li, Elsevier, 2011.

#### **REFERENCE BOOKS:**

1. Embedded Systems- Architecture, Programming and Design by Rajkamal, TMH, 2007.
2. Advanced UNIX Programming, Richard Stevens.
3. Embedded Linux: Hardware, Software and Interfacing – Dr. Craig Hollabaugh.

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**DIGITAL SYSTEM DESIGN WITH FPGAs LAB (Lab – I)**

**Part –I:**

Programming can be done using any compiler. Down load the programs on FPGA/CPLD boards and performance testing may be done using pattern generator (32 channels) and logic analyzer apart from verification by simulation with any of the front end tools.

1. HDL code to realize all the logic gates
2. Design and Simulation of Full Adder, Serial Binary Adder, Multi Precision Adder, Carry Look Ahead Adder.
3. Design of Combinational circuit using Decoders.
4. Design of Combinational circuit using encoder (without and with parity).
5. Design of Combinational circuit using multiplexer.
6. Design of 4 bit binary to gray converter using MUX or Decoders.
7. Design of Multiplexer/ Demultiplexer, comparator in all 3 styles.
8. Modelling of an Edge triggered and Level triggered FFs : D, SR, JK
9. Design of 4-bit binary, BCD counters (synchronous/ asynchronous reset) or any sequence counter
10. Design of a N- bit Register of Serial- in Serial –out, Serial in parallel out, Parallel in Serial out and Parallel in Parallel Out using different FFs.
11. Design of Sequence Detector (Finite State Machine- Mealy and Moore Machines).
12. Design of 4- Bit Multiplier, Divider.
13. Design of ALU to Perform – ADD, SUB, AND-OR, 1's and 2's Compliment,
14. Implementing the above designs on FPGA kits.



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**CMOS ANALOG IC DESIGN LAB (Lab – II)**

**Course Outcomes:** At the end of the laboratory work, students will be able to:

1. Design analog Circuit using CMOS.
2. Use EDA tools like Cadence, Mentor Graphics and other opensource software tools like Ngspice

**List of Experiments:**

- 1) Use  $V_{DD} = 1.8V$  for 0.18  $\mu m$  CMOS process,  $V_{DD} = 1.3V$  for 0.13  $\mu m$  CMOS Process and  $V_{DD} = 1V$  for 0.09  $\mu m$  CMOS Process.
  - a) Plot  $I_D$  vs.  $V_{GS}$  at different drain voltages for NMOS, PMOS.
  - b) Plot  $I_D$  vs.  $V_{GS}$  at particular drain voltage (low) for NMOS, PMOS and determine  $V_t$ .
  - c) Plot  $\log I_D$  vs.  $V_{GS}$  at particular gate voltage (high) for NMOS, PMOS and determine  $I_{OFF}$  and sub-threshold slope.
  - d) Plot  $I_D$  vs.  $V_{DS}$  at different gate voltages for NMOS, PMOS and determine Channel length modulation factor.
  - e) Extract  $V_{th}$  of NMOS/PMOS transistors (short channel and long channel). Use  $V_{DS} = 30 mV$   
 To extract  $V_{th}$  use the following procedure.
    - i. Plot  $g_m$  vs  $V_{GS}$  using NGSPICE and obtain peak  $g_m$  point.
    - ii. Plot  $y = I_D/(g_m)^{1/2}$  as a function of  $V_{GS}$  using Ngspice.
    - iii. Use Ngspice to plot tangent line passing through peak  $g_m$  point in  $y(V_{GS})$  plane and determine  $V_{th}$ .
  - f) Plot  $I_D$  vs.  $V_{DS}$  at different drain voltages for NMOS, PMOS, plot DC load line and calculate  $g_m$ ,  $g_{ds}$ ,  $g_m/g_{ds}$ , and unity gain frequency.

Tabulate your result according to technologies and comment on it.

- 2) Use  $V_{DD} = 1.8V$  for 0.18  $\mu m$  CMOS process,  $V_{DD} = 1.2V$  for 0.13  $\mu m$  CMOS Process and  $V_{DD} = 1V$  for 0.09  $\mu m$  CMOS Process.
  - a) Perform the following
    - i. Plot VTC curve for CMOS inverter and thereon plot  $dV_{out}$  vs.  $dV_{in}$  and determine transition voltage and gain  $g$ . Calculate  $V_{IL}$ ,  $V_{IH}$ ,  $NMH$ ,  $NML$  for the inverter.
    - ii. Plot VTC for CMOS inverter with varying  $V_{DD}$ .
    - iii. Plot VTC for CMOS inverter with varying device ratio.
  - b) Perform transient analysis of CMOS inverter with no load and with load and determine  $t_{pHL}$ ,  $t_{pLH}$ , 20%-to-80%  $t_r$  and 80%-to-20%  $t_f$ . (use  $V_{PULSE} = 2V$ ,  $C_{load} = 50 fF$ )
  - c) Perform AC analysis of CMOS inverter with fanout 0 and fanout 1. (Use  $C_{in} = 0.012 pF$ ,  $C_{load} = 4pF$ ,  $R_{load} = k$ )
- 3) Use Ngspice to build a three stage and five stage ring oscillator circuit in 0.18  $\mu m$  and 0.13  $\mu m$  technology and compare its frequencies and time period.
- 4) Perform the following

- a) Draw small signal voltage gain of the minimum-size inverter in 0.18  $\mu\text{m}$  and 0.13  $\mu\text{m}$  technology as a function of input DC voltage. Determine the small signal voltage gain at the switching point using Ngspice and compare the values for 0.18  $\mu\text{m}$  and 0.13  $\mu\text{m}$  process.
  - b) Consider a simple CS amplifier with active load, as explained in the lecture, with NMOS transistor MN as driver and PMOS transistor MP as load, in 0.18  $\mu\text{m}$  technology. (W/L) MN=5, (W/L) MP=10 and L= 0.5  $\mu\text{m}$  for both transistors.
    - i. Establish a test bench, as explained in the lecture, to achieve  $V_{DSQ} = V_{DD}/2$ .
    - ii. Calculate input bias voltage if bias current = 50  $\mu\text{A}$ .
    - iii. Use Ngspice and obtain the bias current. Compare its value with 50  $\mu\text{A}$ .
    - iv. Determine small signal voltage gain, - 3 dB BW and GBW of the amplifier using small signal analysis in Ngspice (consider 30fF load capacitance).
    - v. Plot step response of the amplifier for input pulse amplitude of 0.1V. Derive time constant of the output and compare it with the time constant resulted from -3dB BW
    - vi. Use Ngspice to determine input voltage range of the amplifier
- 5) Three OP-AMP INA.  $V_{dd} = 1.8\text{V}$   $V_{ss} = 0\text{V}$ , CAD tool: Mentor Graphics DA. Note: Adjust accuracy options of the simulator (setup->options in GUI). Use proper values of resistors to get a three OP-AMP INA with differential-mode voltage gain=10. Consider voltage gain=2 for the first stage and voltage gain=5 for the second stage.
- i. Draw the schematic of op-amp macro model.
  - ii. Draw the schematic of INA.
  - iii. Obtain parameters of the op-amp macro model such that
    - a. low-frequency voltage gain =  $5 \times 10^4$ ,
    - b. unity gain BW ( $f_u$ ) = 500 KHz,
    - c. input capacitance = 0.2 pF,
    - d. output resistance = ,
    - e. CMRR=120 dB
  - iv. Draw schematic diagram of CMRR simulation setup.
  - v. Simulate CMRR of INA using AC analysis (it's expected to be around 6 dB below CMRR of OP-AMP).
  - vi. Plot CMRR of the INA versus resistor mismatches (for resistors of second stage only) changing from -5% to +5% (use AC analysis). Generate a separate plot for mismatch in each resistor pair. Explain how CMRR of OPAMP changes with resistor mismatches.
  - vii. Repeat (iii) to (vi) by considering CMRR of all OP-AMPs to be 90 dB.
- 6) Technology: UMC 0.18  $\mu\text{m}$ ,  $V_{DD}=1.8\text{V}$ . Use MAGIC or Microwind.
- a) Draw layout of a minimum size inverter in UMC 0.18 $\mu\text{m}$  technology using MAGIC Station layout editor. Use that inverter as a cell and lay out three cascaded minimum-sized inverters. Use M1 as interconnect line between inverters.
  - b) Run DRC, LVS and RC extraction. Make sure there is no DRC error. Extract the netlist.
  - c) Use extracted netlist and obtain tPHL, tPLH for the middle inverter using Eldo.
  - d) Use interconnect length obtained and connect the second and third inverter.

Extract the new netlist and obtain tPHL and tPLH of the middle inverter. Compare new values of delay times with corresponding values obtained in part 'c'

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**RESEARCH METHODOLOGY AND IPR**

**Course Objectives:**

- To understand the research problem
- To know the literature studies, plagiarism and ethics
- To get the knowledge about technical writing
- To analyze the nature of intellectual property rights and new developments
- To know the patent rights

**Course Outcomes:** At the end of this course, students will be able to:

- Understand research problem formulation.
- 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:**

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 investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

**UNIT - II:**

Effective literature studies approaches, analysis, Plagiarism, Research ethics

**UNIT - III:**

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 - IV:**

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. 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 - V:**

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

**TEXT BOOKS:**

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"

**REFERENCE BOOKS:**

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Asimov, "Introduction to Design", Prentice Hall, 1962.
6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**VLSI ADVANCED PHYSICAL DESIGN (PC - III)**

**Course Objectives:**

1. To know the IR drop, Power requirements, power mesh design, and electro migration.
2. To know the design of power optimization techniques.
3. To understand the On-chip variations and their impact on performance of design.
4. To know Foundry design rules and implementation methodologies.

**Course Outcomes:** Student will be able to:

1. Design power mesh for given specifications, analyze IR drop and EM issues and fix them.
2. Implement the low power intent of the design using current industry standard UPF.
3. Verify whether the design meets the power intent in UPF
4. Perform physical verification both at LVS & DRC level and fix all issues.

**UNIT - I**

**Power Analysis:** Introduction to power analysis, Goals and objectives, Data preparation, Power mesh design, Static IR analysis, Dynamic IR analysis, Signal and power EM.

**UNIT - II**

**Low Power Design – I:** Introduction, Low power optimization in the SOC flow, Special cells for power management, Architectural techniques for low power.

**UNIT - III**

**Low Power Design – II:** Low power implementation techniques (multi voltage, power gating etc.), UPF formats, Low power checks.

**UNIT - IV**

**Advanced STA:** Hierarchical STA (ILM, XILM, ETM), On-chip variations, Advanced on-chip variations, Parametric on chip variations, Introduction to LVF.

**UNIT - V**

**Physical Verification:** Physical verification - Introduction, goals and objectives, design rule check, layout versus schematic check and electrical rule check, Design for manufacturability - Introduction, DFM aware routing, DFM checks and fixing (pattern matching, MAS).

**TEXT BOOK:**

1. Rakesh Chadha and J. Bhasker, "An ASIC Low Power Primer", Springer, 2013.

**REFERENCE BOOKS:**

1. Voltus Reference Manuals, 17.12.000.
2. Tempus Reference Manual, 17.12.000.
3. Calibre Reference Manual, 2017.1\_17.12

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**SYSTEM VERILOG TEST BENCHES USING UVM (PC - IV)**

**Course Objectives:**

1. To Learn System Verilog for Verification constructs.
2. To understand the UVM methodology.
3. To know UVM implementation for Verilog RTLs.

**Course Outcomes:** Students will be able to:

1. Implement test bench programs using system Verilog.
2. Develop random stimulus and SVAs using system Verilog.
3. Develop a UVM testbench with all its features.

**UNIT – I**

**Verification Basics:** Introduction, Verification need, Test bench components, Directed versus random stimulus, Code coverage versus functional coverage, Types of code coverage, Verification plan and test plan.

**UNIT - II**

**System Verilog – I:** Introduction, Constructs, Interface and object-oriented programming concepts.

**UNIT – III**

**System Verilog – II:** Randomization, Functional coverage and system verilog assertions.

**UNIT – IV**

**UVM Test Bench Architecture:** Introduction, UVM components and UVM phases.

**UNIT – V**

**UVM Methodology:** UVM component configuration and factory, Modelling UVM transactions, UVM sequence, Virtual sequencer, Component communication and UVM reporting.

**TEXT BOOKS:**

1. Janic Bergeron, "Writing Testbenches: Functional Verification of HDL Models", 2nd Ed., Kluwer Academic Publishers, 2003.
2. Stuart Sutherland, Simon Davidmann and Peter Flake, "System Verilog for Design", 2nd Ed., Springer, 2006.

**REFERENCE BOOK:**

1. Reference Verification Methodology User Guide, Version 8.5.11 – Synopsis

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**IOT ARCHITECTURES AND SYSTEM DESIGN (PE - III)**

**Course Objectives**

1. To Know the definition and basic concepts of IoT
2. Learn the interfacing the IoT and M2M
3. To understand the Architecture of IoT

**Course Outcomes:** Students will be able to:

1. Integrate the sensors and actuator depending on the applications
2. Interface the IoT and M2M with value chains
3. Write Python programming for Arduino, Raspberry Pi devices
4. Design IoT based systems such as Agricultural IoT, Vehicular IoT etc.,

**UNIT - I**

**IoT introduction:** Introduction and definition of IoT, Evolution of IoT, IoT growth, Application areas of IoT, Characteristics of IoT, IoT stack, Enabling technologies, IoT levels, IoT sensing and actuation, Sensing types, Actuator types.

**UNIT - II**

**IoT and M2M:** M2M to IoT – A Basic Perspective– Introduction, Differences and similarities between M2M and IoT, SDN and NFV for IoT.M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies.

**UNIT - III**

**IoT Hands-on:** Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino. Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi.

**UNIT - IV**

**IoT Architecture:** IoT Architecture components, Comparing IoT architectures, A simplified IoT architecture, The core IoT functional stack, IoT data management and compute stack

**UNIT - V**

**IoT System design:** Challenges associated with IoT, Emerging pillars of IoT, Agricultural IoT, Vehicular IoT, Healthcare IoT, Smart cities, Transportation and logistics.

**TEXT BOOKS:**

1. Sudip Misra, Anandarup Mukherjee, Arijit Roy "Introduction to IOT", Cambridge University Press.
2. David Hanes, Gonzalo salgueiro, Patrick Grossetete, Rob barton, Jerome henry "IoT Fundamentals Networking technologies, protocols, and use cases for IoT", Cisco Press

**REFERENCE BOOKS:**

1. Cuno pfister, "Getting started with the internet of things", O Reilly Media, 2011
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications.
3. "Internet of Things concepts and applications", Wiley
4. Arshdeep Bahga,Vijay Madiseti "Internet of Things A Hands on approach", Universities Press

5. Shriram K Vasudevan, RMD Sundaram, Abhishek S Nagarajan, "Internet of things" John Wiley and Sons.
6. Massimo Banzi, Michael Shiloh Make: Getting Started with the Arduino, Shroff Publisher/Maker Media Publishers.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**SOC DESIGN (PE - III)**

**Course Objectives:**

1. To learn ASIC design concepts and strategies
2. To know the NISC applications and advantages
3. To familiar with simulation and synthesis process

**Course Outcomes:** At the end of the course, students will be able to:

1. Identify and formulate a given problem in the framework of SoC based design approaches
2. Design SoC based system for engineering applications
3. Realize impact of SoC on electronic design philosophy and Macro-electronics thereby incline towards entrepreneurship & skill development.

**UNIT - I**

**ASIC:** Overview of ASIC types, design strategies, CISC, RISC and NISC approaches for SOC architectural issues and its impact on SoC design methodologies, Application Specific Instruction Processor (ASIP) concepts.

**UNIT - II**

**NISC:** NISC Control Words methodology, NISC Applications and Advantages, Architecture Description Languages (ADL) for design and verification of Application Specific Instruction- set Processors (ASIP), No-Instruction-Set-computer (NISC)- design flow, modeling NISC architectures and systems, use of Generic Netlist Representation - A formal language for specification, compilation and synthesis of embedded processors.

**UNIT - III**

**Simulation:** Different simulation modes, behavioural, functional, static timing, gate level, switch level, transistor/circuit simulation, design of verification vectors, Low power FPGA, Reconfigurable systems, SoC related modeling of data path design and control logic, Minimization of interconnects impact, clock tree design issues.

**UNIT - IV**

**Low power SoC design / Digital system** Design synergy, Low power system perspective- power gating, clock gating, adaptive voltage scaling (AVS), Static voltage scaling, Dynamic clock frequency and voltage scaling (DCFS), building block optimization, building block memory, power down techniques, power consumption verification.

**UNIT - V**

**Synthesis:** Role and Concept of graph theory and its relevance to synthesizable constructs, Walks, trails paths, connectivity, components, mapping/visualization, nodal and admittance graph. Technology independent and technology dependent approaches for synthesis, optimization constraints, Synthesis report, analysis Single core and Multi core systems, dark silicon issues, HDL coding techniques for minimization of power consumption, Fault tolerant designs

**TEXT BOOKS:**

1. Hubert Kaeslin, "Digital Integrated Circuit Design: From VLSI Architectures to CMOS Fabrication", Cambridge University Press, 2008.
2. B. Al Hashimi, "System on chip-Next generation electronics", The IET, 2006

**REFERENCE BOOKS**

1. Rochit Rajsuman, "System-on- a-chip: Design and test", Advantest America R & D Center, 2000
2. P Mishra and N Dutt, "Processor Description Languages", Morgan Kaufmann, 2008
3. Michael J. Flynn and Wayne Luk, "Computer System Design: System-on-Chip". Wiley, 2011

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**DESIGN FOR TESTABILITY (PE - III)**

**Pre-Requisite:** Digital System Design

**Course Objectives:**

1. To acquire the knowledge of fundamental concepts of testing
2. To provide broad understanding the fault simulation.
3. To illustrate the framework of Built-in-self test and Boundary scan methods.

**Course Outcomes:** Students will be able to

1. Acquire verification knowledge and test evaluation
2. Design for testability rules and techniques.
3. Utilize the scan architectures for different digital circuits.
4. Acquire the knowledge of design of built-in-self test.

**UNIT - I**

**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**

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

**UNIT - III**

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

**UNIT - IV**

**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**

**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.

**TEXT BOOK:**

1. M.L. Bushnell, V. D. Agrawal, "Essential of Electronic Testing for Digital, Memory and Mixed Signal VLSI Circuits", Kluwer Academic Publishers.

**REFERENCE BOOKS:**

1. M. Abramovici, M. A. Breuer and A.D Friedman, "Digital Systems and Testable Design", Jaico Publishing House.
2. P. K. Lala, "Digital Circuits Testing and Testability", Academic Press.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**DEVICE MODELLING (PE - IV)**

**Course Objectives:**

1. To obtain the functional relationship among the terminal electrical variables of the device that is to be modeled
2. To know the physical properties of materials and devices
3. To know the MOS transistor low frequency model
4. To understand the characteristics of the FinFETs and its applications

**Course Outcomes:** Students will be able to

1. Develop a functional relationship among the terminal electrical variables of the device that is to be modeled.
2. Describe the behavior of all components successfully
3. Perform the simulation and analyze the VLSI circuits
4. Use the FinFET for various applications

**UNIT - I**

**MOS Capacitor:** Energy band diagram of Metal-Oxide-Semiconductor contacts, Mode of Operations: Accumulation, Depletion, Mid gap, and Inversion, 1D Electrostatics of MOS, Depletion Approximation, Accurate Solution of Poisson's Equation.

**UNIT - II**

**MOS Capacitor Characteristics and Non idealities:** CV characteristics of MOS, LFCV and HFCV, Non-idealities in MOS, oxide fixed charges, interfacial charges.

**UNIT - III**

**The MOS transistor:** Small signal modeling for low frequency and High frequency, Pao-Sah and Brews models; Short channel effects in MOS transistors.

**UNIT - IV**

**The bipolar transistor:** Eber's-Moll model; charge control model; small-signal models for low and high frequency and switching characteristics.

**UNIT - V**

**FinFETs:** I-V characteristics, device capacitances, parasitic effects of extension regions, performance of simple combinational gates and amplifiers, novel circuits using FinFETs and GAA devices.

**TEXT BOOKS:**

1. S. M. Sze, "Physics of Semiconductor Devices", 2<sup>nd</sup> Ed., Wiley Eastern, 1981.
2. Y. P. Tsividis, "Operation and Modelling of the MOS Transistor", McGraw-Hill, 1987.
3. E. Takeda, "Hot-carrier Effects in MOS Transistors", Academic Press, 1995.
4. P. Colinge, "FinFETs and Other Multi-Gate Transistors", Springer. 2009

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**RF IC DESIGN (PE- IV)**

**Pre-requisites:** NIL.

**Course Objectives:**

1. To Learn the concepts of RF frequency analysis and component modelling.
2. To give understanding of various types of RF filter circuits.
3. To familiarize the Concept of RF amplifiers and oscillators.

**Course Outcomes:** Upon completing this course, the student will be able to

1. Analyze the behavior of high frequency components.
2. Calculate the scattering parameters of various RF components and analyze the various filter parameters.
3. Implement component modelling and biasing networks.
4. Design the various RF filters, amplifiers, oscillators and mixers.

**UNIT - I**

**Introduction:** Importance of RF design dimensions and units frequency spectrum RF behavior of passive components, high frequency resistors, high frequency capacitors, high frequency inductor, chip components and circuit board Considerations chip resistors chip capacitors and surface mount inductors.

**UNIT - II**

**RF filter design:** Scattering parameters: definition, meaning chain, scattering matrix, conversion between S- and Z-parameters, signal flow chart modeling, generalization basic resonator and filter configurations: low pass, high pass, band pass and band stop type filters-filter implementation using unit element and kuroda's identities transformations-coupled filters

**UNIT - III**

**Active RF component modeling:** RF diode models: nonlinear and linear models transistor models: large signal and small signal BJT models, large signal and small signal FET models-scattering parameters device characterization.

**Matching and biasing networks:** Impedance Matching using discrete components: Two component matching networks, Forbidden regions, frequency response and quality factor, T and PI matching networks-amplifier classes of operation and biasing networks: classes of operation and efficiency of amplifiers, biasing networks for BJT, biasing networks for FET.

**UNIT - IV**

**RF transistor amplifier design:** Characteristics of amplifier-amplifier power relations RF sources, transducers power gain, additional power relations-stability consideration: stability circles, unconditional stability and stabilization methods-unilateral and bilateral design for constant gain noise figure circles-constant VSWR circles.

**UNIT - V**

**RF oscillators and mixers:** Basic oscillator models: Negative resistance oscillator, feedback oscillator design, design steps, quads oscillators- fixed frequency, high frequency oscillator- basic characteristics of mixers: concepts, frequency domain considerations, single ended mixer design, single and double balanced mixers.

**TEXT BOOKS:**

1. RF circuit design- theory and applications - Reinhold Ludwig Pavel bsetchko- Pearson education India 2000
2. Radio frequency and microwave communication circuits- analysis and design- devendrak Mishra- wiley student edition- john wiley and sons inc

**REFERENCE BOOKS:**

1. Radiofrequency and microwave electronics mathew m rarmaneah PEI
2. RF circuit design christoper BOWIK Cheryl aijuni and john butler Elsevier science 2008
3. Secrets of RF circuit design joseph jcarr TMH 2000
4. Design of RF and microwave amplifiers and oscillators peter ID
5. Madison abrief artech house 2000.
6. The design of CMOS radio frequency integrated circuits thomas h Lee 2/e Cambridge University Press 2004.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - I YEAR- II SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**HARDWARE AND SOFTWARE CO-DESIGN (PE - IV)**

**Course Objectives:**

1. To know the Co-design Issues, prototype and emulation techniques
2. To learn Architecture specific techniques
3. To know the different tool for design

**Course Outcomes:** Students will be able to:

1. Acquire the knowledge on various models of Co-design.
2. Explore the interrelationship between Hardware and software in a embedded system
3. Acquire the knowledge of firmware development process and tools during Co-design.
4. Implement validation methods and adaptability.

**UNIT - I**

**Co-Design Issues:** Co- Design Models, Architectures, Languages, A Generic Co-design Methodology.

**Co-Synthesis Algorithms:** Hardware software synthesis algorithms: hardware – software partitioning distributed system co-synthesis.

**UNIT- II**

**Prototyping and Emulation:** Prototyping and emulation techniques, prototyping and emulation environments, future developments in emulation and prototyping architecture specialization techniques, system communication infrastructure.

**Target Architectures:** Architecture Specialization techniques, System Communication infrastructure, Target Architecture and Application System classes, Architecture for control dominated systems (8051- Architectures for High performance control), Architecture for Data dominated systems (ADSP21060, TMS320C60), Mixed Systems.

**UNIT - III**

**Compilation Techniques and Tools for Embedded Processor Architectures:** Modern embedded architectures, embedded software development needs, compilation technologies, practical consideration in a compiler development environment.

**UNIT - IV**

**Design Specification and Verification:** Design, co-design, the co-design computational model, concurrency coordinating concurrent computations, interfacing components, design verification, implementation verification, verification tools, interface verification.

**UNIT - V**

**Languages for System – Level Specification and Design-I:** System – level specification, design representation for system level synthesis, system level specification languages,

**Languages for System – Level Specification and Design-II:** Heterogeneous specifications and multi-language co-simulation, the cosymsa system and lycos system.

**TEXT BOOKS:**

1. Hardware / Software Co- Design Principles and Practice – Jorgen Staunstrup, Wayne Wolf – Springer, 2009.
2. Hardware / Software Co- Design - Giovanni De Micheli, Mariagiovanna Sami, Kluwer Academic Publishers, 2002.

**REFERENCE BOOKS:**

1. A Practical Introduction to Hardware/Software Co-design -Patrick R. Schaumont, Springer, 2010

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH. - II YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**ADVANCED COMPUTER ARCHITECTURE (PE - V)**

**Course Objectives:**

1. To understand the fundamental of computer design
2. To know the pipelines and parallelism concepts
3. To know the issues in interconnect networks

**Course Outcomes:** At the end of the course, students will be able to:

1. Familiarize the instruction set, memory addressing of Computer
2. Handle the issues in pipelining and parallelism
3. Familiarize the practical issues in inter network

**UNIT - I**

**Fundamentals of Computer Design:** Fundamentals of Computer design, Changing faces of computing and task of computer designer, Technology trends, Cost price and their trends, measuring and reporting performance, quantitative principles of computer design, Amdahl's law. Instruction set principles and examples- Introduction, classifying instruction set- memory addressing- type and size of operands, operations in the instruction set.

**UNIT - II**

**Pipelines:** Introduction, basic RISC instruction set, Simple implementation of RISC instruction set, Classic five stage pipe line for RISC processor, Basic performance issues in pipelining, Pipeline hazards, Reducing pipeline branch penalties.

**Memory Hierarchy Design:** Introduction, review of ABC of cache, Cache performance, Reducing cache miss penalty, Virtual memory.

**UNIT - III**

**Instruction Level Parallelism the Hardware Approach:** Instruction-Level parallelism, Dynamic scheduling, Dynamic scheduling using Tomasulo's approach, Branch prediction, high performance instruction delivery- hardware based speculation.

**ILP Software Approach:** Basic compiler level techniques, static branch prediction, VLIW approach, Exploiting ILP, Parallelism at compile time, Cross cutting issues -Hardware verses Software.

**UNIT - IV**

**Multi Processors and Thread Level Parallelism:** Multi Processors and Thread level Parallelism- Introduction, Characteristics of application domain, Systematic shared memory architecture, Distributed shared – memory architecture, Synchronization.

**UNIT - V**

**Inter Connection and Networks:** Introduction, Interconnection network media, Practical issues in interconnecting networks, Examples of inter connection, Cluster, Designing of clusters.

**Intel Architecture:** Intel IA- 64 ILP in embedded and mobile markets Fallacies and pit falls

**TEXT BOOK:**

1. John L. Hennessy, David A. Patterson, "Computer Architecture: A Quantitative Approach", 3rd Edition, Elsevier.



**REFERENCE BOOKS:**

1. John P. Shen and Miikko H. Lipasti, "Modern Processor Design: Fundamentals of Super Scalar Processors", 2002, Beta Edition, McGraw-Hill
2. Kai Hwang, Faye A.Brigs., "Computer Architecture and Parallel Processing", Mc Graw Hill.
3. DezsóSima, Terence Fountain, Peter Kacsuk, "Advanced Computer Architecture - A Design Space Approach", Pearson Education.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- II YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**NANOMATERIALS AND NANOTECHNOLOGY (PE – V)**

**Course Objectives:**

1. To know the characteristics of nano materials and their utility
2. To understand the basic science behind the design and fabrication of nano scale systems.
3. To know the basic principle of working of MEMS and its applications

**Course Outcomes:** At the end of the course, students will be able to:

1. Formulate new engineering solutions for current problems and competing technologies for future applications.
2. Made inter disciplinary projects applicable to wide areas by clearing and fixing the boundaries in system development.
3. Gather detailed knowledge of the operation of fabrication and characterization devices to achieve precisely designed systems

**UNIT - I**

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, precipitative, reactive, hydrothermal/solvo thermal methods, suitability of such methods for scaling , potential Uses.

**UNIT- II**

Fundamentals of nanomaterials, Classification, Zero-dimensional nanomaterials, One-dimensional, nanomaterials, Two-dimensional nanomaterials, Three dimensional nanomaterials, Low-Dimensional Nanomaterials and its Applications, Synthesis, Properties, and Applications of Low-Dimensional Carbon-Related Nanomaterials.

**UNIT- III**

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**

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

**UNIT - V**

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

**TEXT BOOKS:**

1. I Gusev and A A Rempel, "Nanocrystalline Materials", Cambridge International Science Publishing, 1 st Indian edition by Viva Books Pvt. Ltd. 2008.
2. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath, James Murday, "Nanoscience and Nanotechnology", Tata McGraw Hill Education 2012.

**REFERENCE BOOKS**

1. Kenneth J. Klabunde and Ryan M. Richards, "Nanoscale Materials in Chemistry", 2 edition, John Wiley and Sons, 2009.
2. Bharat Bhushan, "Springer Handbook of Nanotechnology", Springer, 3<sup>rd</sup> edition, 2010.
3. Kamal K. Kar, "Carbon Nanotubes: Synthesis, Characterization and Applications", Research Publishing Services; 1 st edition, 2011, ISBN-13: 978-9810863975.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M.TECH.- II YEAR- I SEMESTER**  
**VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN**  
**HARDWARE SECURITY (PE - V)**

**Course Objectives:**

1. To initiate students to hardware attacks (side channel, faults, probing)
2. To give possible counter measures and more secure system designs
3. To the passive and active bus probing
4. To know the injecting forged data on communication links

**Course Outcomes: Students will be able to**

1. Design a more secure systems by knowing countermeasures of various hardware attacks
2. Experiment the impressive efficiency of hardware attacks
3. Monitor computation time or power consumption to reveal secrets
4. Design a secure systems which lead to privilege escalation and compromise

**UNIT - I**

**Introduction to Hardware Security:** Overview of the computing system, Layers of computing system, Hardware security vs hardware trust, Attacks, Vulnerabilities and counter measures, Conflict between security and Test/Debug, Evolution of Hardware security, Birds eye view, Common hardware security primitives, Performance reliability vs security, Security architecture

**UNIT - II**

**Hardware Trojans:** Introduction, SoC design flow, Hardware Trojans, Hardware Trojans in FPGA designs, Hardware Trojans taxonomy, Trust benchmarks, Countermeasures against Hardware Trojans, Software induced hardware trojan attacks,

**UNIT - III**

**Side-Channel Attacks:** Introduction, Background on side-channel attacks, Power analysis attacks, Electromagnetic side-channel attacks, Fault injection attacks, Timing attacks, Covert channels, Side channel resistant design, Software induced side channel attacks.

**UNIT - IV**

**Test Oriented Attacks:** Introduction, Scan based attacks, JTAG based attacks, Pre-silicon security and trust assessment for SoCs, Post-silicon security and trust assessment for SoCs.

**UNIT - V**

**Physical Attacks and Counter Measures:** Introduction, Reverse engineering, Probing attacks, Invasive fault injection attack, Security issues in IP based SoC design, Security issues in FPGA, PCB security challenges and attack modes.

**TEXT BOOKS:**

1. Swarup Bhunia, Mark Tehranipoor, "Hardware Security A hands on learning approach", Morgan Kaufmann Publisher, An Imprint of Elsevier.
2. Douglas R Stinson, "Cryptography: Theory and practice", CRC Press

**REFERENCE BOOKS:**

1. Alfred J Menezes, Paul C Van Oorschot, Vanstone, A. Scott "Handbook of applied Cryptography", CRC Press
2. Stefan Mangard, Elisabeth Oswald, Thomas Popp, "Power analysis attacks: Revealing the secrets of smart cards", Springer-Verlag.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**ENGLISH FOR RESEARCH PAPER WRITING (Audit Course - I & II)**

**Prerequisite:** None

**Course objectives:** Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission

**UNIT-I:**

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

**UNIT-II:**

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

**UNIT-III:**

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

**UNIT-IV:**

key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

**UNIT-V:**

skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions. useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

**TEXT BOOKS/ REFERENCES:**

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
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

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**DISASTER MANAGEMENT (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to

- learn to demonstrate a 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 work in

**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.

**TEXT BOOKS/ REFERENCES:**

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company.
2. Sahni, Pardeep Et. Al. (Eds.)," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep &Deep Publication Pvt. Ltd., New Delhi.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**SANSKRIT FOR TECHNICAL KNOWLEDGE (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

- 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:** Students 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 concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

**TEXT BOOKS/ REFERENCES:**

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-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.



**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**VALUE EDUCATION (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

**Course outcomes:** Students will be able to

- Knowledge of self-development
- Learn the importance of Human values
- Developing the overall personality

**UNIT-I:**

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements

**UNIT-II:**

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

**UNIT-III:**

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline, Punctuality, Love and Kindness.

**UNIT-IV:**

Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

**UNIT-V:**

Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation, Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

**TEXT BOOKS/ REFERENCES:**

1. Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**CONSTITUTION OF INDIA (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

**Course Outcomes:** Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

**UNIT-I:**

**History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working),  
**Philosophy of the Indian Constitution:** Preamble, Salient Features.

**UNIT-II:**

**Contours of Constitutional Rights & Duties:** Fundamental Rights Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

**UNIT-III:**

**Organs of Governance:** Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualification, Powers and Functions.

**UNIT-IV:**

**Local Administration:** District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**UNIT-V:**

**Election Commission:** Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

**TEXT BOOKS/ REFERENCES:**

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**PEDAGOGY STUDIES (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:** Students will be able to:

- Review existing evidence on the review 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:** 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:**

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

**UNIT-II:**

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

**UNIT-III:**

Evidence on the effectiveness of pedagogical practices, Methodology for the indepth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the scho 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:**

**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:**

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

**TEXT BOOKS/ REFERENCES:**

1. Ackers J, 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 Curriculum Studies, 36 (3): 361-379.
3. Akyeamong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeamong K, Lussier K, Pryor J, 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.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) *Read India: A mass scale, rapid, 'learning to read' campaign*.
7. [www.pratham.org/images/resource%20working%20paper%202.pdf](http://www.pratham.org/images/resource%20working%20paper%202.pdf).

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD  
M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**STRESS MANAGEMENT BY YOGA (Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

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

**Course Outcomes:** Students will be able to:

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

**UNIT-I:**

Definitions of Eight parts of yog. (Ashtanga)

**UNIT-II:**

Yam and Niyam.

**UNIT-III:**

Do`s and Don`ts in life.

- i) Ahinsa, satya, astheya, bramhacharya and aparigraha
- ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

**UNIT-IV:**

Asan and Pranayam

**UNIT-V:**

- i) Various yog poses and their benefits for mind & body
- ii) Regularization of breathing techniques and its effects-Types of pranayam

**TEXT BOOKS/ REFERENCES:**

1. 'Yogic Asanas for Group Training-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**  
**M. Tech. (VLSI/VLSI DESIGN/VLSI SYSTEM DESIGN)**

**PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS**  
**(Audit Course - I & II)**

**Prerequisite:** None

**Course Objectives:**

- 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:** Students 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:**

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:**

Neetisatakam-Holistic development of personality

- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

**UNIT-III:**

Approach to day to day work and duties.

- Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

**UNIT-IV:**

Statements of basic knowledge.

- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:

**UNIT-V:**

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

**TEXT BOOKS/ REFERENCES:**

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.