Savitribai Phule Pune University

Faculty of Science and Technology

Syllabus for

T.E. Electronics Engineering
(VLSI Design and Technology)

(Course 2019)

(w.e.f. June 2025)

Savitribai Phule Pune University, Pune
T.E. Electronics Engineering
(VLSI and Design Technology)
2019 Course
(With effect from Academic Year 2025-26)

Semester-V

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304181 *	Digital Communication	03	-	-	30	70	-	-	-	100	03	-	-	03
304401	Computer Architecture	03	-	-	30	70		-	-	100	03	-	-	03
304402	Analog and Digital CMOS Design	03	-	-	30	70	-	-	-	100	03	-	-	03
304184*	Microcontrollers	03	-	-	30	70	-	-	-	100	03	-	-	03
304403	Elective - I	03	-	-	30	70	-	-	-	100	03	-	-	03
304404	Digital Communication Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304405	Analog and Digital CMOS Design Lab	-	02	-	-	-	25	-	50	75	-	01	-	01
304406	Microcontroller Lab	-	02	-	-	-	-	50	-	50	-	01	-	01
304407	Elective I Lab	-	02	-	-	-	-	25	-	25	-	01	-	01
304190*	Skill Development	-	02	-	-	-	25	-	-	25	-	01	-	01
304191A	Mandatory Audit Course 5	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total	**15**	**10**	**-**	**150**	**350**	**50**	**125**	**50**	**725**	**-**		**-**	**-**
									Total Credit		**15**	**05**	**-**	**20**

***These courses are common with TE (E&TC) Engg 2019 Pattern**

Elective -I

1) Database Management
2) Design for testability
3) Statistics and Numerical Techniques
4) Computer Networks

Savitribai Phule Pune University, Pune
T.E. Electronics Engineering
(VLSI and Design Technology)
2019Course
(With effect from Academic Year 2025-26)

Semester-VI

Course Code	Course Name	Teaching Scheme (Hours/Week)			Examination Scheme and Marks						Credit			
		Theory	Practical	Tutorial	In-Sem	End-Sem	TW	PR	OR	Total	TH	PR	TUT	Total
304408	Electromagnetics and Radio Frequency Circuits	03	-	01	30	70	25	-	-	125	03	-	01	04
304193*	Project Management	03	-	-	30	70	-	-	-	100	03	-	-	03
304409	Embedded Processors	03	-	-	30	70	-	-	-	100	03	-	-	03
304410	Elective-II	03	-	-	30	70	-	-	-	100	03	-	-	03
304411	Embedded Processors Lab	-	02	-	-	-	-	50		50	-	01	-	01
304412	System Verilog Lab	-	02	-	-	-	-	50	-	50		01		01
304413	Elective-II Lab	-	02	-	-	-	-		25	25	-	01	-	01
304414	Internship**	-	-	-	-	-	100	-	-	100	-	-	04	04
304415	Mini Project	-	04	-	-	-	25	-	50	75	-	02	-	02
304191 B	Mandatory Audit Course 6	-	-	-	-	-	-	-	-	-	-	-	-	-
	Tota	**12**	**10**	**01**	**120**	**280**	**150**	**100**	**75**	**725**				
									Total Credit		**12**	**05**	**05**	**22**

Abbreviations:
In-Sem: In semester End-Sem: End semester TH: Theory TW : Term Work
PR: Practical OR: Oral TUT: Tutorial

Note: Students of T.E. (Electronics Engineering) VLSI and Design Technology have to opt any one of the audit courses from the list of audit courses prescribed by BoS (Electronics & Telecommunications Engineering)

*These courses are common with TE (E&TC) Engg 2019 Pattern

Elective -II

1) Fundamentals of JAVA Programming
2) ASIC Design
3) Machine Learning
4) Network Security

SEMESTER - V

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304181: Digital Communication

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Signals & Systems
3. Control Systems
4. Digital Circuits
5. Electronic Circuits.

Companion Course, if any: Digital Communication Lab

Course Objectives: To make the students understand

- To familiarize students with various digital modulation techniques used in digital communication systems.
- To equip students the students with tools required for performance analysis of digital communication systems.
- To introduce the students with the concept of information theory & coding techniques.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Apply the statistical theory for describing various signals in a communication system.

CO2: Understand and explain various digital modulation techniques used in digital communication systems andanalyze their performance in presence of AWGN noise.

CO3: Describe and analyze the digital communication system with spread spectrum modulation.

CO4: Analyze a communication system using information theoretic approach.

CO5: Use error control coding techniques to improve performance of a digital communication system.

Course Contents

Unit I	Random Processes & Noise	(07 Hrs.)

Random Processes: Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation and Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density.

Mathematical Representation of Noise: Some Sources of Noise, Frequency-domain Representation of Noise, Superposition of Noises, Linear Filtering of Noise, Quadrature Components of Noise, Representation of Noise using Orthonormal Coordinates.

Mapping of Course Outcomes for Unit I	**CO1: Apply the statistical theory for describing various signals in a communication system.**

Unit II	Digital Modulation-I	(07 Hrs.)

Baseband Signal Receiver: Probability of Error, Optimal Receiver Design.

Digital Modulation: Generation, Reception, Signal Space Representation and Probability of Error Calculation for Binary Phase Shift Keying (BPSK), Binary Frequency Shift Keying (BFSK), Quadrature Phase Shift Keying (QPSK), M-ary Phase Shift Keying (MPSK).

Mapping of Course Outcomes for Unit II	**CO2: Understand and explain various digital modulation techniques used in digital communication systems and analyze their performance in presence of AWGN noise.**

Unit III	Digital Modulation-II	(07 Hrs.)

Generation, Reception, Signal Space Representation and Probability of Error Calculation for Quadrature Amplitude Shift Keying (QASK), M-ary FSK (MFSK), Minimum Shift Keying (MSK), Pulse Shaping to reduce Interchannel and Intersymbol Interference, some Issues in transmission and reception, Orthogonal Frequency Division Multiplexing (OFDM), Comparison of digital modulation systems.

Mapping of Course Outcomes for Unit III	**CO2: Understand and explain various digital modulation techniques used in digital communication systems and analyze their performance in presence of AWGN noise.**

Unit IV	Spread Spectrum Modulation	(06 Hrs.)

Use of Spread Spectrum, Direct Sequence (DS) Spread Spectrum, Spread Spectrum and Code Division Multiple Access (CDMA), Ranging Using DS Spread Spectrum, Frequency Hopping (FH) Spread Spectrum, **Pseudorandom (PN) Sequences:** Generation and Characteristics, Synchronization in Spread Spectrum Systems

Mapping of Course Outcomes for Unit IV	**CO3: Describe and analyze the digital communication system with spread spectrum modulation.**

Unit V	Information Theoretic Approach to Communication System	(07 Hrs.)
Introduction to information theory, Entropy and its properties, Source coding theorem, Huffman coding, Shannon-Fano coding, Discrete memory less channel, Mutual information, Channel capacity, Channel coding theorem, Differential entropy and mutual Information for continuous ensembles, Information Capacity theorem.		
Mapping of Course Outcomes for Unit V	**CO4: Analyse a communication system using information theoretic approach.**	
Unit VI	**Error-Control Coding**	**(06 Hrs.)**
Linear Block Codes: Coding, Syndrome and error detection, Error detection and correction capability, Standard array and syndrome decoding. Cyclic Codes: Coding & Decoding, Convolutional Codes: Coding & Decoding, Introduction to Turbo Codes & LDPC Codes.		
Mapping of Course Outcomes for Unit VI	**CO5: Use error control coding techniques to improve performance of a digital communication system.**	

Learning Resources

Text Books:

1. Taub, Schilling and Saha, "Principles of Communication Systems", McGraw-Hill, 4th Edition,
2. B.P. Lathi, Zhi Ding , "Modern Analog and Digital Communication System", Oxford University Press, 4th Edition.

Reference Books:

1. Bernard Sklar, Prabitra Kumar Ray, "Digital Communications Fundamentals and Applications", Pearson Education, 2nd Edition
2. Wayne Tomasi, "Electronic Communications System", Pearson Education, 5th Edition
3. A.B Carlson, P B Crully, J C Rutledge, "Communication Systems", Tata McGraw Hill Publication, 5th Edition
4. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition
5. Simon Haykin, "Digital Communication Systems", John Wiley & Sons, 4th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course on **"Digital Communications"**

   Link of the Course: https://nptel.ac.in/courses/108/102/108102096/

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304401:Computer Architecture

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End-Sem (Theory): 70 Marks

Prerequisite Courses, if any: Digital Circuits

Companion Course, if any: Elective-I: 1)Computer Network,2) Microcontrollers

Course Objectives:

- To understand the basic structure and functioning of a computer system.
- To analyze the instruction set architecture (ISA) and how it affects computer performance.
- To study the design of data path and control units for a processor.
- To explore concepts of memory hierarchy, including cache and virtual memory.
- To understand the organization of I/O systems and peripheral devices.
- To introduce advanced topics like pipelining, RISC, and parallel processing.

Course Outcomes: After completing the course, students will be able to:

CO1: Describe the functional units of a computer system.

CO2: Interpret and analyze different instruction formats and ISAs.

CO3: Design the data path and control unit for basic processors.

CO4: Explain the concept and organization of memory hierarchy.

CO5: Understand I/O mechanisms and interface design.

CO6: Analyze advanced architectural features such as pipelining and multicore processors.

Course Contents

Unit I	Introduction to Computer Architecture	(08 Hrs.)

Evolution of computer architecture, Functional units of a computer, Von Neumann Vs. Harvard Architecture, Basic performance metrics (CPI, MIPS, Execution Time, and Benchmarks), Instruction cycle: fetch-decode-execute.

Mapping of Course Outcomes for Unit I	CO1: Describe the functional units of a computer system.

Unit II	Instruction Set Architecture (ISA)	(06 Hrs.)

Types of instruction sets: RISC Vs CISC, Addressing modes (Immediate, direct, indirect, indexed) and instruction formats (fixed, variable, hybrid), Instruction types: data transfer, arithmetic, logical, control, Stack-based Vs. register-based ISA, Assembly language examples

Mapping of Course Outcomes for Unit II	CO2: Interpret and analyze different instruction formats and ISAs.

Unit III	Data Path and Control	(06 Hrs.)
Register Transfer Language (RTL), ALU design and operations Control unit design: Hardwired Vs. Micro programmed control, Design of a basic CPU using control signals, Single-cycle and multi-cycle data path. Instruction pipeline and hazard handling (structural, data, control)		
Mapping of Course Outcomes for Unit III	**CO3: Design the data path and control unit for basic processors.**	

Unit IV	Memory Hierarchy	(08 Hrs.)
Types of memory: RAM, ROM, cache, secondary, Cache memory organization: mapping techniques (direct, associative, set-associative) Virtual memory: paging, segmentation, TLB, page replacement policies, Memory access techniques and performance Cache write policies: write-back Vs write-through, SRAM Vs DRAM.		
Mapping of Course Outcomes for Unit IV	**CO4: Explain the concept and organization of memory hierarchy.**	

Unit V	Input/output Systems	(06 Hrs.)
I/O interfaces and buses I/O techniques: programmed I/O, interrupt-driven I/O, DMA I/O devices and controllers Interrupt structure and priority		
Mapping of Course Outcomes for Unit V	**CO5: Understand I/O mechanisms and interface design.**	

Unit VI	Advanced Topics in Architecture	(06 Hrs.)
Instruction-level parallelism Pipelining: stages, pipeline hazards, techniques to resolve hazards, Superscalar architecture VLIW, SIMD, MIMD (Flynn's Classification), Multi-core and multithreaded processors, Introduction to GPU architecture.		
Mapping of Course Outcomes for Unit VI	**CO6: Analyze advanced architectural features such as pipelining and multicore processors.**	

Learning Resources

Text Books:

1. M. Morris Mano – Computer System Architecture

References:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky – Computer Organization
2. William Stallings – Computer Organization and Architecture
3. David A. Patterson & John L. Hennessy – Computer Organization and Design

MOOC Courses Links:

1. Introduction to the book: Basic of Computer Architecture

https://onlinecourses.nptel.ac.in/noc23_cs67/preview

2. Computer Architecture & organization

https://nptel.ac.in/courses/106105163

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304402: Analog and Digital CMOS Design

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Basics of Semiconductor devices like MOSFET, BJT, DIODE.
2. Basics of Passive devices like capacitor, inductor, resistor.
3. Basics of operational amplifier.

Companion Course, if any: code – Analog and Digital CMOS Design Lab

Course Objectives:

- To provide knowledge of the different types of MOS devices and their use.
- To understand and design the different types of amplifier
- To demonstrate the analysis and design of comparators using CMOS
- To study CMOS design rules and layout design.
- To study design issues and delay models.
- To understand power and design interconnect.

Course Contents

Unit I	Analog MOS Devices	(06 Hrs.)

MOS Devices: 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.

Analog CMOS Sub-Circuits: MOS Switch, MOS Diode, MOS Active Resistor, Current Sinks and Sources, Current Mirrors, Degeneration, Cascode current Mirror Current and Voltage References, Band gap Reference.

Mapping of Course Outcomes for Unit I	CO1: Design and analysis of the basics MOSFET circuits using PSPICE Simulation software

Unit II	CMOS amplifier	(06 Hrs.)
CMOS Amplifiers Inverters, Differential Amplifiers, Cascode Amplifiers, Current Amplifiers, Output Amplifiers, High Gain Amplifiers Architectures. 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.		
Mapping of Course Outcomes for Unit II	**CO2: Build and verify various Amplifiers.**	

Unit III	Comparators	(06 Hrs.)
Comparators Characterization of Comparator, Two-Stage, Open-Loop Comparators, Other Open-Loop Comparators, Improving the Performance of Open-Loop Comparators, Discrete-Time Comparators.		
Mapping of Course Outcomes for Unit III	**CO3: Study Various Comparators**	

Unit IV	CMOS Technologies and CMOS design rules	(06 Hrs.)
CMOS Technologies and CMOS design rules: Inverter cross section, Fabrication Process, Layout Design Rules, Gate layouts, stick diagram of Adders, Multiplexers, flip-flops etc. Design for Boolean expression, multiplexers, adders and shift registers. CMOS enhancement process.		
Mapping of Course Outcomes for Unit IV	**CO4: Build CMOS design and draw stick diagram**	

Unit V	CMOS design issues and Delays	(06 Hrs.)
Issues in CMOS design: Beyond Conventional CMOS design, CAD issues, manufacturing issues, pitfalls and fallacies. Delay and transient response, RC delay models, linear delay models, logical efforts, delay in multistage logic network, gate diffusion capacitance, Equivalent RC circuits.		
Mapping of Course Outcomes for Unit V	**CO5: study the model to calculate delays.**	

Unit VI	Power and interconnect Design	(06 Hrs.)
Dynamic power , static power, energy delay optimization, low power architecture, wire geometry, interconnect modelling, interconnect impact, interconnect engineering, logical effort with wires.		
Mapping of Course Outcomes for Unit VI	**CO6: study various power architecture.**	

Learning Resources

Text Books:

1. CMOS VLSI design - CMOS VLSI Design,A Circuits and Systems Perspective Fourth Edition ,Neil H. E. Weste,David Money Harris
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 Digital Integrated Circuits analysis and design- Sung-Mo Kang, Yusuf Leblebici, Tata McGraw-Hill Edition.

MOOC / NPTEL Courses:

1. NPTEL Course “CMOS Analog VLSI Design”,Prof. A.N. Chandorkar,IIT Bombay
nptel.ac.in/courses/117101105

2. NPTEL Course “CMOS Digital VLSI Design”By Prof. Sudeb Dasgupta | IIT Roorkee
https://onlinecourses.nptel.ac.in/noc25_ee11/preview

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304184: Microcontrollers

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Digital Logic Design
2. Electronic Components and Hardware
3. Basics of C Language.

Companion Course, if any: Microcontroller Lab

Course Objectives: During the course study students will be able to

- Understand architecture and features of 8051 and PIC18FXX Microcontroller.
- Learn interfacing of real-world peripheral devices with microcontroller.
- Explore different features of PIC 18F Microcontroller with Architecture.
- Use concepts of timers and interrupts of PIC 18 in programming.
- Design and develop microcontroller based embedded application.
- Demonstrate real life applications using PIC 18.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Understand the fundamentals of microcontroller and programming.

CO2: Interface various electronic components with microcontrollers.

CO3: Analyze the features of PIC 18F XXXX.

CO4: Describe the programming details in peripheral support.

CO5: Develop interfacing models according to applications.

CO6: Evaluate the serial communication details and interfaces.

Course Contents

Unit I	Introduction to Microcontroller Architecture	(06 Hrs.)
Difference between microprocessor and microcontroller Introduction to the Microcontroller classification, Feature and block diagram of 8051 and explanation, Program Status Word (PSW), 8051. Overview of Instruction set, memory organization, Interrupt structure, timers and its modes, Serial communication: concept of baud rate, Data transmission and reception using Serial port. Sample programs of data transfer, Delay using Timer (0&1) and interrupt, Data transmission and reception using Serial port. I/O Port Programming, All programs in C language.		
Mapping of Course Outcomes for Unit I	**CO1: Understand the fundamentals of microcontroller and programming**	

Unit II	IO Port Interfacing-I	(06 Hrs.)
Pin diagram and its functioning Port structure, IO Interfacing Requirements, Interfacing of: LEDS, Keys, 7-segment multiplexed display, DAC 0808, ADC 0809 Stepper motor, Relay, Buzzer, Opto-isolators, \ Design of Data acquisition System (DAS): All programs in C language		
Mapping of Course Outcomes for Unit II	**CO2: Interface various electronic components with microcontrollers**	

Unit III	PIC 18F XXXX Microcontroller Architecture	(06 Hrs.)
Comparison of PIC family, Criteria for Choosing Microcontroller, features, PIC18FXX architecture with generalized block diagram. MCU, Program and Data memory organization, Bank selection using Bank Select Register, Pin out diagram, Reset operations, Watch Dog Timers, Configuration registers and oscillator options (CONFIG), Power down modes , Brief summary of Peripheral support, Overview of instruction set.		
Mapping of Course Outcomes for Unit III	**CO3: Analyze the features of PIC18F XXXX**	

Unit IV	Peripheral Support in PIC 18FXXXX	(06 Hrs.)
Timers and its Programing (mode 0 &1), Interrupt Structure of PIC18F with SFR, PORTB change Interrupts, use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP, Block diagram of in-built ADC with Control registers, Sensor interfacing using ADC: All programs in embedded C.		
Mapping of Course Outcomes for Unit IV	**CO4: Describe the programming details in peripheral support**	

Unit V	Real Word Interfacing With 18FXXXX	(06 Hrs.)
Port structure with programming, Interfacing of LED, LCD and Key board, Motion Detectors, DAC for generation of waveform, Design of PIC test Board and debugging, Home protection System: All programs in embedded C.		
Mapping of Course Outcomes for Unit V	**CO5: Develop interfacing models according to applications**	

Unit VI	Serial Port Programming interfacing with 18FXXXX	(06 Hrs.)
Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI & I2C), USART (Receiver and Transmitter), interfacing of RTC (DS1307) with I2C and EEPROM with SPI. Design of Traffic Light Controller; All programs in embedded C.		
Mapping of Course Outcomes for Unit VI	**CO6: Evaluate the serial communication details and interfaces**	

Learning Resources

Text Books:

1. Mahumad Ali Mazadi, Janice Gillispie Mazadi, Rolin D McKinlay, "The 8051 Microcontroller & Embedded Systems (Using Assembly and C)", PHI, 2nd Edition
2. Mahumad Ali Mazadi, Rolin D McKinlay and Danny Causey, "PIC Microcontroller & Embedded System", Pearson Education, 3rd Edition

Reference Books:

1. Kenneth J. Ayala, 'The 8051 Microcontroller Architecture, Programming and Applications', Cengage Learning, 3rd Edition
2. Ajay Deshmukh, "Microcontrollers Theory and Applications", TATA McGraw Hill, 4th Edition
3. Peatman, John B, "Design with PIC Microcontroller", Pearson Education PTE, 1st Edition
4. Data Sheet of PIC 18Fxxxx series

MOOC / NPTEL Courses:

1. NPTEL Course **"Microcontroller and Applications"**

Link of the Course: https://nptel.ac.in/courses/117/104/117104072/

https://nptel.ac.in/courses/108/105/108105102/

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304403 -A: Database Management (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Data Structures

Companion Course, if any: Database Management Lab

Course Objectives:

- To understand fundamental concepts of database from its design to its implementation.
- To analyze database requirements and determine the entities involved in the system and with one another.
- To manipulate database using SQL Query to create, update and manage Database.
- Be familiar with the basic issues of transaction processing and concurrency control.
- To learn and understand Parallel Databases and its Architectures.
- To learn and understand Distributed Databases and its applications.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Ability to implement the underlying concepts of a database system.

CO2: Design and implement a database schema for a given problem-domain using data model.

CO3: Formulate, using SQL/DML/DDL commands, solutions to a wide range of query and update problems.

CO4: Implement transactions, concurrency control, and be able to do Database recovery.

CO5: Able to understand various Parallel Database Architectures and its applications.

CO6: Able to understand various Distributed Databases and its applications.

Course Contents

Unit I	Introduction to DBMS	(07 Hrs.)

Introduction to Database Management Systems, Purpose of Database Systems, Database-System Applications, Data Abstraction and Database System Structure.

Relational Model: Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus.

Entity-Relationship model: Basic Concepts, Entity Set, Relationship Sets and Weak Entity Sets, Mapping Cardinalities, Keys, E-R diagrams, Design Issues, Extended E-R Features, Converting E-R & EER diagram into tables.

Mapping of Course Outcomes for Unit I	**CO1: Ability to implement the underlying concepts of a database system.**

Unit II	Relational Database Design	(06 Hrs.)

Basic concepts, CODD's Rules, Relational Integrity: Domain, Referential Integrities, Enterprise Constraints, Database Design: Features of Good Relational Designs, Normalization, Atomic Domains and First Normal Form, Decomposition using Functional Dependencies, Algorithms for Decomposition, 2NF, 3NF, 4NF and BCNF.

Mapping of Course Outcomes for Unit II	**CO2: Design and implement a database schema for a given problem-domain using data model.**

Unit III	Basics of SQL	(07 Hrs.)

DDL, DML, DCL, Structure: Creation, Alteration, Defining constraints – Primary key, Foreign key, Unique key, Not null, Check, IN operator, Functions - Aggregate Functions, Built-in Functions –Numeric, Date, String Functions, Set operations, sub-queries, correlated subqueries, Use of group by, having, order by, join and its types, Exist, Any, All, view and its types.

Transaction control commands: Commit, Rollback, Save-point PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers.

Mapping of Course Outcomes for Unit III	**CO3: Formulate, using SQL/DML/DDL commands, solutions to a wide range of query and update problems.**

Unit IV	Database Transactions Management	(07 Hrs.)

Basic concepts of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and Non-recoverable Schedules, Concurrency Control: Need, Locking Methods, Deadlock handling and Time-stamp based Protocols.

Mapping of Course Outcomes for Unit IV	**CO4: Implement transactions, concurrency control, and be able to do Database recovery.**

Unit V	Parallel Databases	(06 Hrs.)
Introduction to Database Architectures: Multi-user DBMS Architectures, Case study- Oracle Architecture. **Parallel Databases:** Performance Parameters for Parallel Databases, Types of Parallel Database Architecture, Evaluating Parallel Query in Parallel Databases and Virtualization on Multicore processors.		
Mapping of Course Outcomes for Unit V	**CO5: Able to understand various Parallel Database Architectures and applications.**	

Unit VI	Distributed Databases	(07 Hrs.)
Distributed Databases: Distributed Database Management System, Factors Encouraging DDBMS, Advantages of Distributed Databases, Types of Distributed Databases, Architecture of Distributed Databases, Distributed Database Design, Distributed Data Storage, and Distributed Transaction: Basics, Failure modes, Commit Protocols, Concurrency Control in Distributed Database.		
Mapping of Course Outcomes for Unit VI	**CO6: Able to understand various Distributed Databases and its applications.**	

Learning Resources

Text Books:

1. A. Silberschatz, H.F. Korth and S. Sudarshan , "Database System Concepts", McGraw Hill, 6th Edition.
2. C.J. Date, A. Kannan, S. Swamynathan "An introduction to Database Systems", Pearson, 8th Edition.

Reference Books:

1. Martin Gruber, "Understanding SQL", Sybex Publications.
2. Ivan Bayross, "SQL- PL/SQL", BPB Publications, 4th Edition.
3. S.K. Singh, "Database Systems: Concepts, Design and Application", Pearson, Education, 2nd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Database Management System"**

   Link of the Course: https://nptel.ac.in/courses/106/106/106106220/

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

304403-B: Design for Testability (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: Digital Logic Design

Companion Course, if any: 204208 - VLSI Laboratory

Course Objectives: To make the students understand

- Describe the Testability of Combinational Circuits.
- Explain the Testability of Sequential Circuits.
- Illustrate the concepts of Built In Self-Test.
- Demonstrate the design for Testability of Memory Circuits.
- Illustrate Self Checking Circuits using various techniques.

Course Outcomes: On completion of the course, learner will be able to –

- **CO1:** Explain about Stuck at Faults in digital circuits.
- **CO2:** Discuss about various testable design of Multilevel Combinational Circuits.
- **CO3:** Learn the concept Controllability and observability and design rules of Ad-Hoc Design.
- **CO4:** Explain about various test Pattern generation techniques for BIST and describe various techniques of Output Response Analysis.
- **CO5:** Discuss about various RAM models and demonstrate various test algorithms for RAM's.
- **CO6:** Illustrate about basic concepts of Self checking circuits, demonstrate various methods of Self-Checking circuits and use the concepts of self–checking checkers in Combinational and Sequential circuits.

Course Contents

Unit I	Introduction of Design for Testability	(06 Hrs.)
Types of fault, Need of Design for Testability (DFT), DFT Guideline, Testability, Fault models, Path sensitizing, Test pattern generation, Sequential circuit test, Built In Self Test, JTAG & Boundary scan, TAP Controller.		
Mapping of Course Outcomes for Unit I	**CO1:** Explain about Stuck at Faults in digital circuits	

Unit II	Design for Testability for Combinational Circuits	(06 Hrs.)
Stuck at Faults, Fault diagnosis by Path Sensitization Technique, Reed Muller's expansion technique, OR-AND-OR design, Automatic Synthesis of Testable Logic, Testable design of Multilevel Combinational Circuits.		
Mapping of Course Outcomes for Unit II	**CO2:**Discuss about various testable design of Multilevel Combinational Circuits.	

Unit III	Design for Testability for Sequential Circuits	(06 Hrs.)
Controllability and observability, Ad-Hoc Design Rules for Improving Testability, Scan Path Technique for testable Sequential Circuit design, Level Sensitive Scan Design (LSSD), Random Access Scan Technique, partial Scan, and Boundary Scan.		
Mapping of Course Outcomes for Unit III	**CO3:** Learn the concept Controllability and observability and design rules of Ad-Hoc Design.	

Unit IV	Built-In Self-Test	(08 Hrs.)
Test Pattern generation for BIST, Output Response Analysis, Circular BIST, Built-In logic Block observer, Self-Testing using an MISR and Parallel Shift register Sequence generator, LSSD On-Chip Self-Test.		
Mapping of Course Outcomes for Unit IV	**CO4:** Explain about various test Pattern generation techniques for BIST and describe various techniques of Output Response Analysis.	

Unit V	Testable Memory Design	(06 Hrs.)
RAM fault Models, Test Algorithms for RAMs-Galloping 0's and 1's,Walking 0's and 1's, March Test, MATS Check Board Test, Detection of Pattern-Sensitive Faults, BIST Techniques for RAM Chips.		
Mapping of Course Outcomes for Unit V	**CO5:** Discuss about various RAM models and demonstrate various test algorithms for RAM's.	

Unit VI	Self - Checking Circuits	(08 Hrs.)
Basic concepts of Self checking circuits, Design of Totally Self Checking checker- Self Checking using m/n codes, Equality Checkers, Berger code, Self-Checking Combinational Circuits, Self -Checking Sequential Circuit.		
Mapping of Course Outcomes for Unit VI	**CO6:** Illustrate about basic concepts of Self checking circuits, demonstrate various methods of Self-Checking circuits and use the concepts of self–checking checkers in Combinational and Sequential circuits.	

Learning Resources

Text Books:

1. Lala, Parag K. An Introduction to Logic Circuit Testing, Morgan & Claypool, 2009.
2. Parag K. Lala, Digital Circuits Testing and Testability, Academic Press, 1997.
3. M. Abramovili, M.A. Breues, A. D. Friedman, Digital Systems Testing and Testable Design , Jaico publications, 2001.

References:

1. ZainalabedinNavabi, Digital System Test and Testable Design Using HDL Models and Architectures, Springer, 2011.
2. Parag K. Lala, Fault Tolerant & Fault Testable Hardware Design , PS Publications, 2002.
3. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 2 nd edition, 2000.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304403-C: Statistics and Numerical Techniques (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Data Structures1. Engineering Mathematics I
2. Engineering Mathematics II

Course Objectives:

To educate students in selecting and employing suitable statistical measures and numerical methods to address the problem and comprehend the outcome

Course Outcomes

After completion of this course, student will be able to

CO1: Apply the concept of data representation and analysis in various fields of engineering like image processing etc.

CO2: Apply the concepts of Correlation and Regression in result analysis and Business forecasting using EXCEL.

CO3: Understand the basic concepts of probability and distribution to realize the logic of data sciences.

CO4: Select suitable numerical techniques and ascertain solutions for ordinary algebraic equations.

CO5: Acquire knowledge on diverse techniques for numerical differentiation and integration.

CO6: Select suitable numerical techniques and ascertain solutions for ordinary differential equations

Course Contents

Unit I	Data representation and Analysis	(06 Hrs.)

Revision of basic concept of statistics, Measure of central tendency and dispersion, Statistical diagram: scattered diagram, histogram, ogive curve, pie charts etc., Use of EXCEL software to compute statistical measures and diagrammatic representation

Mapping of Course Outcomes for Unit I	**CO1**: Apply the concept of data representation and analysis in various fields of engineering like image processing etc.

Unit II	Regression and Correlation	(06 Hrs.)

Measure of association between two variables. Types of correlation, Karl Pearson's Coefficient of correlation and its mathematical properties, Spearman's Rank correlation and its interpretations, Regression Analysis, linear regression equations, properties of regression coefficients, Use in forecasting and estimation computational through EXCEL.

Mapping of Course Outcomes for Unit II	**CO2:** Apply the concepts of Correlation and Regression in result analysis and Business forecasting using EXCEL

Unit III	Random variable and Probability distribution	(06 Hrs.)

Revision of elementary concept of Probability, Discrete and continuous random variable, Mass, Density and cumulative distribution functions, expected values and variance of random variable, Standard probability distributions.

Mapping of Course Outcomes for Unit III	**CO3**: Understand the basic concepts of probability and distribution to realize the logic of data sciences.

Unit IV	Numerical Solution of Algebraic equation	(06 Hrs.)

Introduction, The Bisection Method, The Method of False Position, The Iteration Method, Newton-Raphson Method, Newton's Inverse formula and square root formula, Generalized Newton's Method, Principles of least squares.

Mapping of Course Outcomes for Unit IV	**CO4**: Select suitable numerical techniques and ascertain solutions for ordinary algebraic equations.

Unit V	Interpolation	(06 Hrs.)

Finite differences - Operators Δ, ∇, D - Relation between operators, Linear interpolation, Lagrange's, Interpolation with equal intervals, Newton forward interpolation formula, Newton backward interpolation formula, Numerical differentiation

Mapping of Course Outcomes for Unit V	**CO5**: Acquire knowledge on diverse techniques for numerical differentiation and integration.

Unit VI	Numerical Integration and Ordinary Differential Equations	(06 Hrs.)
Rectangle rule, Trapezoidal Rule, Simpson's 1/3 rule 3.2 Taylor's Series method, Picard's Method, Euler's method, Runga-Kutta method		
Mapping of Course Outcomes for Unit VI	**CO6:** Select suitable numerical techniques and ascertain solutions for ordinary differential equations	

Learning Resources

Reference Books:

1. Miller and Freund's Probability and Statistics for Engineers: Richard A Johnson, Prentice Hall of India.
2. Numerical Methods, M K Jain, S R K Iyengar, R K Jain, New Age Intl. publisher, 2012
3. Introduction Methods of Numerical Analysis, S. S. Sastry PHI Learning Private Limited 2011
4. Numerical Methods in Engineering with Python3 1st Jaan Kiusalaas Cambridge 2013
5. Numerical Methods: An Inquiry Based Approach with Python 1st Eric Sullivan Independent 2020

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

304403-D: Computer Networks (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Digital Communication

Companion Course, if any: Computer Networks Lab

Course Objectives:

- To understand the concepts of networking, its standards and protocols.
- To learn controlling techniques in networking at different layers.
- To learn protocols at different layers of reference model.
- To understand routing and networking in inter and intra domain.
- To learn network programming.
- To understand applications, protocols and its implication in networks.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.

CO2: Understand the working of controlling techniques for flawless data communication using data link layer protocols.

CO3: Learn the functions of network layer, various switching techniques and internet protocol addressing.

CO4: Explore various interior and exterior, unicasting and multicasting protocols.

CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.

CO6: Illustrate the use of protocols at application layer.

Course Contents

Unit I	Basics of Network & Physical Layer	(07 Hrs.)
Types of networks, Network topologies, Design issues for Layers, Network models, OSI model & TCP / IP protocol suite, Types of addressing.		
Mapping of Course Outcomes for Unit I	**CO1: Design LAN using appropriate networking architecture, topologies, transmission media, and networking devices.**	

Unit II	Data Link Layer	(06 Hrs.)
Data link control, Framing, Flow and error control, Protocols for Noiseless, and Noisy Channels, HDLC, Point to Point Protocol, Media Access Control: Random Access, Controlled Access- Reservation, Channelizationprotocols.		
Mapping of Course Outcomes for Unit II	**CO2: Understand the working of controlling techniques for flawless data communication using data link layer protocols**	

Unit III	Network Layer -I	(07 Hrs.)
Introduction to Network Layer: Network-Layer Services, Circuit switching, Packet Switching, Network-Layer Performance, IPv4 Addresses, Forwarding of IP Packets, Network Layer Protocols: Internet Protocol (IP), ICMPv4, Next Generation IP: IPv6 Addressing, The IPv6 Protocol, The ICMPv6 Protocol, Transition from IPv4 to IPv6.		
Mapping of Course Outcomes for Unit III	**CO3: Learn the functions of network layer, various switching techniques and internet protocol addressing.**	

Unit IV	Network Layer - II	(07 Hrs.)
Unicast & Multicast Routing: Introduction, Routing Algorithms, Unicast Routing Protocols, Introduction, Multicasting Basics, Intra-domain Multicast Protocols, Inter-domain Multicast Protocols, IGMP Distance Vector, Link State, Path Vector, Routing in Internet: RIP, OSPF, BGP.		
Mapping of Course Outcomes for Unit IV	**CO4: Explore various interior and exterior, unicasting and multicasting protocols.**	

Unit V	Transport Layer	(06 Hrs.)
Introduction to transport layer, User Datagram Protocol, Transmission Control Protocol, TCP Congestion Policy, Stream Control Transmission Protocol, Congestion control and QoS, socket programing .		
Mapping of Course Outcomes for Unit V	**CO5: Analyze data flow using TCP/UDP Protocols, congestion control techniques for QoS.**	

Unit VI	Application Layer	(05 Hrs.)
Introduction to Application Layer, Standard Client Server Protocols: World Wide Web and HTTP, Telnet, FTP, Email, SMTP, IMAP, POP, DNS, BOOTP, DHCP.		
Mapping of Course Outcomes for Unit VI	**CO6: Illustrate the use of protocols at application layer.**	

Learning Resources

Text Books:

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill, 5th Edition.
2. Achyut S Godbole, "Data Communication and Networking", Tata McGraw-Hill, 1st Edition.

Reference Books:

1. Andrew S. Tannenbaum, "Computer Networks", Pearson Education,4th Edition, 2003
2. Wayne Tomasi, "Introduction to Data Communication and Networking", Pearson Education, 1st Edition.
3. Greg Tomsho, Ed Tittel, David Johnson. "Guide to Networking Essentials", Thomson India Learning, 5th Edition, 2007.
4. William Stallings, "Data and Computer Communication", Pearson Education, 8th Edition, 2000
5. James F. Kurouse & W. Rouse, "Computer Networking: A Top down Approach", Pearson Education, 6th Edition.

MOOC / NPTEL Courses:

1. Computer Networks - Course (swayam2.ac.in)
2. Introduction to Computer Networks & Internet Protocols - Course (swayam2.ac.in)
3. Computer Networks and Internet Protocol - Course (nptel.ac.in)
4. NPTEL Course **"Computer Networks"**

Link of the Course: https://nptel.ac.in/courses/106/105/106105183/

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304404: Digital Communication Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 50 Marks

Prerequisite Courses, if any:

1. Principles of Communication Systems
2. Signals & Systems
3. Control Systems
4. Digital Circuits
5. Electronic Circuits.

Companion Course, if any: Digital Communication Theory

Guidelines for Instructor's Manual

Design minimum 10 Assignments on the topics listed under Group A & B Below & prepare your own Instructor's Manual. Minimum 2 experiments should be designed from group A & B each and Minimum 3 can be from group C &D each. **Use of high end equipment like USRP is encouraged for Group A & B experiments.**

Guidelines for Student's Lab Journal

The student's Lab Journal can be experimental write-ups. It should include following as applicable: Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

Guidelines for Lab /TW Assessment

The practical examination will be based on the work carried out by the student in the Lab course. Suitablerubrics can be used by the internal & external examiner for assessment.

List of Laboratory Experiments

Group A (Any Two)

1.	Study of BPSK transmitter & receiver using suitable hardware setup/kit.
2.	Study of QPSK transmitter & receiver using suitable hardware setup/kit.
3.	Study of BFSK transmitter & receiver using suitable hardware setup/kit.
4.	Study of Baseband receiver performance in presence of Noise using suitable hardware setup/kit.

Group B (Any Two)	
1.	Study of Error Control Coding using suitable hardware setup/kit.
2.	Study of DSSS transmitter and receiver using suitable hardware setup/kit.
3.	Study of FHSS transmitter and receiver using suitable hardware setup/kit.
Group C (Any Three)	
1	Simulation study of Performance of M-ary PSK .
2	Simulation study of Performance of M-ary QAM.
3	Simulation study of OFDM transmitter & receiver.
4	Simulation study of random processes. Find various statistical parameters of the random process.
5	Simulation Study of performance of BPSK receiver in presence of noise.
6	Simulation Study of CDMA technique.
Group D (Any Three)	
1	Simulation study of Source Coding technique.
2	Simulation study of various Entropies and mutual information in a communication system.
3	Simulation Study of Linear Block codes.
4	Simulation Study of cyclic codes.
5	Simulation Study of Convolutional codes
6	Simulation Study of Performance of Digital communication system with error control coding.

Virtual LAB Links:

1. **Link:** **https://www.etti.unibw.de/labalive/index/digitalmodulation/**

2. **Link:** **https://vlab.amrita.edu/index.php?sub=59&brch=163&sim=262&cnt=970**

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304405: Analog and Digital CMOS Design Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	TW: 25 Marks Oral: 50 Marks

Prerequisite Courses, if any: --

Companion Course, if any: - Analog and Digital CMOS Design

List of Laboratory Experiments

Group A (any 5)

1.	Design, Simulate and estimate frequency response of common source / common drain amplifier.
2.	Design, Simulate and estimate frequency response of cascode amplifier.
3.	Analysis the performance of differential operational amplifier for various types of loads.
4.	Design and simulate the non-inverting comparator.
5.	Design the MOS based current mirror circuit
6.	To design and implement Voltage based Oscillator

Group B (any 5)

7	Design CMOS Ring Oscillator.
8	Design and simulate given Boolean expression using CMOS.
9	Design and simulate half and full adder using CMOS..
`10	Design 2:1 Mux using Transmission gates
11	Design the CMOS layout of D latch
12	Study stick diagram in details. Design CMOS EXOR gate and draw the stick diagram of it.
	Virtual LAB Links: https://vlsi-iitg.vlabs.ac.in/CMOS_simulator.html https://iitg.ac.in/cseweb/vlab/vlsi/ **Note: Additional 2 experiments to be performed using the virtual labs.**

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304406: Microcontroller Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 50 Marks

Prerequisite Courses, if any: -

Companion Course, if any: Microcontroller

List of Laboratory Experiments

Group A (Any Three)

1.	Simple programs on Memory transfer.
2.	Parallel port interacting of LEDS—Different programs (flashing, Counter, BCD, HEX, Display of Characteristic)
3.	Interfacing of Multiplexed 7-segment display (counting application)
4.	Waveform Generation using DAC
5.	Interfacing of Stepper motor to 8051- software delay using Timer

Group B (Any Three)

6.	Write a program for interfacing button, LED, relay & buzzer as follows
7.	Interfacing of LCD to PIC 18FXXXX
8.	Interfacing of 4X4 keypad and displaying key pressed on LCD.
9.	Generate square wave using timer with interrupt

Group C (Any Two)

11.	Interfacing serial port with PC both side communication.
12.	Interface analog voltage 0-5V to internal ADC and display value on LCD
13.	Generation of PWM signal for DC Motor control.
14.	Interfacing OF RTC using I2C protocol

Virtual LAB Links:

http://vlabs.iitb.ac.in/vlabs-dev/labs/8051-Microcontroller-Lab/labs/index.php

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304407-A: Database Management Lab (Elective – I)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 25 Marks

Prerequisite Courses, if any:

Companion Course, if any: Database Management System

List of Laboratory Experiments

Group A- Database Programming Languages – SQL

1.	Study of Open Source Relational Databases: MySQL
2.	Design and develop at SQL DDL statements which demonstrate the use of SQL objects such as Table, View, Index, Sequence and Synonym.
3.	Design and develop at least 5SQL queries for suitable database application using SQL DML statements: Insert and Select with operators and functions.
4.	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: Update and Delete with operators and functions.
5.	Design and develop at least 5 SQL queries for suitable database application using SQL DML statements: all types of Join and Sub-Query.

Group B- Database Programming Languages – PL / SQL

6.	Write a PL/SQL block of code for the following requirements:- **Schema:** 1. Borrower (Roll no., Name, Date of Issue, Name of Book, Status) 2. Fine (Roll no, Date, Amt.) • Accept roll no. & name of book from user. • Check the number of days (from date of issue), if days are between 15 to 30 then fine amount will be Rs 5per day. • If no. of days>30, per day fine will be Rs 50 per day & for days less than 30, Rs. 5 per day. • After submitting the book, status will change from I to R. • If condition of fine is true, then details will be stored into fine table. **Frame the problem statement for writing PL/SQL block in line with above statement requirements.**

7.	**PL/SQL Stored Procedure and Stored Function.** Write a Stored Procedure namely proc_Grade for the categorization of student. If marks scored by students in examination is <=1500 and marks>=990 then student will be placed in distinction category if marks scored are between 989 and900 category is first class, if marks 899 and 825 category is Higher Second Class Write a PL/SQL block for using procedure created with above requirement. Stud_Marks(name, total_marks) Result(Roll,Name, Class). **Frame the separate problem statement for writing PL/SQL Stored Procedure and function, in line with above statement. The problem statement should clearly state the requirements.**
8.	**Database Trigger** (All Types: Row level and Statement level triggers, Before and After Triggers). Write a database trigger on Library table. The System should keep track of the records that are being updated or deleted. The old value of updated or deleted records should be added in Library_Audit table. **Frame the problem statement for writing Database Triggers of all types, in-line with above statement. The problem statement should clearly state the requirements.**
Group C- Mini Project: Database Project Life Cycle	
9.	Implement MYSQL/Oracle database connectivity with PHP/python/Java Implement Database navigation operations (add, delete, edit,) using ODBC/JDBC.
10.	Using the database concepts covered in Group A & Group B & connectivity concepts covered in Group C, students in group are expected to design and develop database application with following details: **Requirement Gathering and Scope Finalization** **Database Analysis and Design:** • Design Entity Relationship Model, Relational Model, Database Normalization • Implementation: • Front End: Java/Perl/PHP/Python/Ruby/.net • Backend: MYSQL/Oracle • Database Connectivity: ODBC/JDBC **Testing: Data Validation** Group of students should submit the Project Report which will be consist of documentation related to different phases of Software Development Life Cycle: Title of the Project, Abstract, Introduction, scope, Requirements, Data Modeling features, Data Dictionary, Relational Database Design, Database Normalization, Graphical User Interface, Source Code, Testing document, Conclusion. Instructor should maintain progress report of mini project throughout the semester from project group and assign marks as a part of the term work.
Virtual LAB Links: **Link of the Virtual Lab: http://vlabs.iitb.ac.in/vlabs-dev/labs/dblab/index.php**	

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University Third Year of Electronics Engineering VLSI and Design Technology (2019 Course) 304407-B: Design for Testability Lab (Elective – I)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: -VLSI LAb		
Companion Course, if any: - Digital Logic Design		
List of Laboratory Experiments		
(ANY Eight)		
1.	Study of Design for Testability by using various parameters.	
2.	To design ,Synthesis and simulate PRBS generator.	
3.	To design ,Synthesis and simulate logic for testability for 4 bit shift register.	
4.	Design and simulation for three level OR-AND-OR design.	
5	To design combinational logic circuits, create stuck at fault and simulate with a without faults.	
6.	To design a logic circuit for hardware lock which accepts certain test patterns, open write test bench and Simulate.	
7.	To design and simulate test pattern sequence generator which sends typical patterns to certain “Logic Under Test ”(LUT) periodically. The LUT accepts the pattern and generates a signal if the pattern is correct.	
8.	To design and simulate Built In Self-Test (BIST) logic circuits for a typical 8*8 RAM	
9.	To design and simulate logic circuits for various fault models.	
10.	To demonstrate boundary Scan check process.	

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304407-C: Statistics and Numerical methods Lab (Elective - I)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 25 Marks

List of the Experiments:

1.	Use EXCEL/ Python to compute statistical measures and diagrammatic representation
2.	Write a program to use correlation for forecasting and estimation computation.
3.	Plot various types of probability distributions using Python
4.	Implement any two from the following a) To develop a computer program for finding the inverse of a function using Newton's method. b) To understand and implement polynomial curve fitting to approximate a relationship between data points using a polynomial of arbitrary degree. c) To understand and implement the Bisection Method for finding a root of a given equation.
5.	Implement any one from the following a) To implement the Secant method for finding roots of a given function and analyze its convergence behavior for different functions and initial guesses. b) To apply the Newton-Raphson method to find the root of a nonlinear equation representing a network analysis problem.
6.	Implement any one from the following a) To understand and implement Newton's Forward Difference Formula for numerical differentiation b) Lagrange's Interpolation Method for Finding $f(x)$ for a Given x
7.	Implement any three from the following a) To understand and implement the Rectangular Formula for approximating definite integrals numerically. b) To understand and implement the Trapezoidal Rule for approximating definite integrals numerically. c) Writing a Program for Approximating Definite Integral using Simpson's ⅓ Formula. d) Numerical solving of initial value problems employing Euler's method. e) Numerical solving of initial value problems utilizing the Runge-Kutta method.

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

304407-D: Computer Networks Lab (Elective – I)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 25 Marks

Prerequisite Courses, if any: -

Companion Course, if any: Computer Networks

List of Laboratory Experiments

NOTE: All experiments should be implemented using Open-Source Tools: Wireshark, Packet Tracer and C / C++

Group A (Any Four)

1.	Implementation of LAN using suitable multiuser Windows operating System and demonstrating client-server and peer to peer mode of configuration.
2.	Simulating various Networks (LAN, WAN) using relevant network devices on Simulator **a)** Ping **b)** ipconfig / ifconfig **c)** Host name **d)** Whois **e)** Netstat **f)** Route **g)** Tracert/Traceroute/ Tracepath **h)** NSlookup **i)** ARP **j)** Finger **k)** Port Scan / nmap
3.	Observe and note the details of the live type of traffic (ARP, Frame analysis, ethernet) from interface using packet capture and analysis tool
4.	Using a Network Simulator (e.g., packet tracer) Configure router using RIP
5.	Capture and note the packet of HTTP /FTP /Telnet / DHCP Protocol using TCP-stream learn sequence of packets being sent and received.

Group B (Any Four)

1.	Socket Programming in C/C++ on TCP Client, TCP Server.
2.	Write a program to simulate leaky bucket/token bucket.
3.	Observe and note the working of protocols using PING / TRACEROUTE / PATHPING and capture packets in LAN using packet capture and analysis tool.
4.	Configure servers like HTTP / FTP and understand packet sequence and data flowing between client-server using packet analysis tools.
5.	Executing Proxy, web Server using simulator.
6.	Executing Telnet, DHCP Server using simulator.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304190: Skill Development

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Term work: 25 Marks

Prerequisite Courses, if any:

1. Basics of Electronics Components
2. Working of Operational amplifier
3. Basics of Electronics measurement instruments and Tools

Companion Course, if any: --

Course Objectives:

- To build and upgrade practical knowledge of an individual.
- To make students Employable with required skill set.
- To promote youth work to assist "Make in India" initiative.
- To grow and build confidence among students on specific skill sets.
- To cultivate Entrepreneur mindset after getting required experience.
- To improve professional skills such as moral/ethics/team work/communication skill/lifelong learning etc.

Course Outcome: After Successfully completing the course,

CO1: Student should recognize the need to engage in independent and life-long learning in required skill sets

CO2: Student needs to experience the impact of industries on society by visiting different industries and understand the importance of industrial products for analog and digital circuits and systems.

CO3: Student has to make use of the modern electronic and IT Engineering Tools and Technologies for solving electronic engineering problems.

CO4: Student would be able to communicate effectively at different technical and administrative levels.

CO5: Student will exhibit leadership skills both as an individual and as a member in a team in multidisciplinary environment.

List of Laboratory Experiments

Group A (Any Three)

Testing /Measurement/Calibration/Troubleshooting/Maintenance/Installation

1.	**Case studies on Study, Testing and maintenance of Batteries.** A. Apply skill sets mentioned in ***#Group A Skills 1***and may be covered as per availability of labor equipment's. **OR** B. Apply Skill sets mentioned in ***#Group A Skills 1***may be covered by visiting any Automobile service centers/Battery maintenance service centers or related industry. **Note: Batteries of e-Vehicle & Technology Involved (Lithium Batteries etc.)**
2.	**Case study on Automotive Electronics. (Sensors, Clusters, Controls, Semiconductor's devices etc.)** A. Apply Skill set mentioned in ***#Group A Skills 1and Group A Skills 2*** which is related to automotive electronics may be covered as per availability of lab or equipment's. **OR** B. Apply Skill sets mentioned in ***#Group A Skills 1***may be covered by visiting any Automobile service centers or related industry.
3.	**Case study on Biomedical Instrumentation** A. Apply Skill set mentioned in ***#Group A Skills 3*** which is related to automotive electronics may be covered as per availability of lab or equipment's. **OR** B. Visit biomedical instrument maintenance service centers **OR** C. Visit Hospitals or related industry. **Note: Students are expected to know about sensors technology / Interface / maintenance / calibration of electronic instrumentation of some of these equipment's.**
4.	Troubleshooting and maintenance of PCB Boards &Controllers
5.	Troubleshooting and maintenance of Power supply

	Group B (Any Two) **Software / Hardware Design**
1.	**Design and Simulate dc-dc boost converter for battery-based applications** Design a conventional dc-dc boost converter to step-up the battery voltage of 5 V to 10 V. Drawthe circuit diagram and find required value of duty ratio. Implement the circuit in open-source TINA software. Plot the graphs of output voltage and PWM signal with respect to time.
2.	**Design a web page(s)** A. Using different text formatting tags B. With links to different pages and allow navigation between pages C. With Images, tables and frames D. Using style sheets to maintain uniform style for all web pages E. Using a form that uses all types of controls. F. Validate all the controls placed on the form using Java Script. **Note: Use maximum above points while designing Web page.**
3.	**SMPS Design** A. Design and Simulate of SMPS of 24 V @ 1A. **OR** B. Design, simulate and Implement buck converter using ICs like LM3842 / LM 3524 and measure performance parameters like 1. Load regulation 2. Line regulation 3. Ripple rejection 4. Output impedance and 5. Dropout voltage. 6. Note: Hardware based assignments: **Note : EDA tool (NI Multisim/ORCAD/PSPICE / Altium Designer suite etc.)**
4.	**Design and Simulate dc-dc boost converter for battery-based applications** Design a conventional dc-dc boost converter to step-up the battery voltage of 5 V to 10 V. Draw the circuit diagram and find required value of duty ratio. Implement the circuit in open-source TINA software. Plot the graphs of output voltage and PWM signal with respect to time.

5.	**Design and Simulate PID Controller based on OP-AMP** Design an analog PID controller to track a reference voltage of 5 V in a circuit. Draw the circuit diagram of the controller and implement the circuit in open-source TINA software. Change the reference voltage to 10 V and show that the circuit can still track this changed reference voltage. Show the effect of 3 controller gains viz. proportional gain, integral gain and derivative gain on the output response.
Group C (Compulsory) **Industrial Visit (Practical Visit)**	
1.	Industrial visit to Maintenance /Calibration/ service department of Electronics industry/Hospitals/Service centers etc. Student Should visit to related field and submit report in a predefined format.
2.	Industrial visit to software industry to understand the different processes and skills required as a software professional engineer
Group D (Compulsory) **Documentation/Specification /Manual**	
1.	Study of documentation/specification /Manual/SOP **Note: Based on group B assignment, student need to prepare user manual / SOP and make and effective presentation.**

Learning Resources

Reference Books:

1. Ron Lenk, "Practical design of Power Supplies", John Wiley & Sons, 2005.
2. Abraham I. Pressman," Switching Power Supply Design", McGraw-Hill, 3rd Edition, 2009.
3. Khandpur R.S., "Biomedical Instrumentation", TMH, 3rd Edition.
4. W Bosshart, "Printed Circuit Boards - Design & Technology", Tata McGraw Hill, 1st Edition.
5. D.Patranabis, "Principles of Industrial Instrumentation", TMH Publishing Co., 2nd Edition, 2008
6. R.K. Jain, "Mechanical and Industrial Measurement", Khanna Publishers, New Delhi,11th Edition,1999,
7. L.D. Goettsche, "Maintenance of Instruments and systems – Practical guides for measurement and control", International Society for Automation, 2nd Edition, 1995.
8. Henry W.Ott, "Noise Reduction Techniques in Electronic Systems", John Wiley & Sons, USA,2nd Edition.
9. Kim R Fowler, "Electronic Instrument Design", Oxford University Press, 1997, 1st Edition.
10. Jiuchun Jiang, And Caiping Zhang, "Fundamentals and Applications of Lithium-Ion Batteries In Electric Drive Vehicles", Wiley Publication, 1st Edition.
11. Web Technologies: Black Book, 2018, Dreamtech Press (1 January 2018), ISBN-10: 9386052490, ISBN-13: 978-9386052490
12. Jennifer Robbins, "Learning Web Design: A Beginner's Guide to HTML, CSS, JavaScript, and Web Graphics", Shroff/O'Reilly, 5th Edition.
13. Thomas Powell, "Web Design: The complete Reference", Tata McGraw Hill; 2nd Edition.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304191 (A): Mandatory Audit Course - 5

Teaching Scheme:	Credit	Examination Scheme:
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List of Courses to be opted (Any one) under Mandatory Audit Course 5

- Developing Soft skills and Personality
- Entrepreneurship and IP Strategy
- Urbanization and Environment
- Environmental & Resource Economics
- Environment and Development
- Globalization and Culture

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in- semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be done at institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses. The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register for the corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute hasto maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.

On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet

SEMESTER - VI

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304408: Electromagnetics and Radio Frequency Circuits

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week **Tutorial: 01 Hrs./Week**	**04**	**Insem (Theory): 30 Marks** **End Sem (Theory): 70 Marks** **TW: 25 Marks**

Prerequisite Courses, if any:

1. Vectors, Vector Calculus
2. Coordinate Geometry, Cartesian, Cylindrical, Spherical
3. Engineering Mathematics III

Companion Course, if any: Electromagnetic Field Theory Tutorials

Course Objectives: To make the students understand

- Provide the foundation and essentials of Electromagnetic theory essential to subsequent courses of radiation, microwave and wireless communications
- Expose the students to the fundamental principles of magneto statics and analyse magnetic field behaviour in various configurations
- Provide understanding of electromagnetic field effects in VLSI circuits and the design of CMOS-based RF circuits.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Apply the basic electromagnetic principles and determine the fields (E & H) due to the given source.
CO2: Apply boundary conditions to the boundaries between various media to interpret behaviour of the fields
either sides.
CO3: State, Identify and Apply Maxwell's equations (integral and differential forms) in both the forms (Static, time-varying or Time-harmonic field) for various sources
CO4: Possess the skills to analyse the effects of parasitic capacitance and inductance in VLSI circuits
CO5. Design and analyse RF CMOS circuits, including amplifiers, oscillators, and mixers
CO6: Design RF CMOS Circuit

Course Contents

Unit I	Electrostatics	(08Hrs.)

Basic concepts of electric and magnetic field, Scalar and vector fields: Physical significance of Gradient, Divergence, Curl, Electric field intensity(E), Displacement Flux Density(D), Gauss's law, Electric potential(V), Potential Gradient, E/D/V due to uniform sources (point charge, infinite line charge, infinite surface charge) s.

Boundary conditions (dielectric-dielectric, conductor –dielectric), significance and applications of Poisson 's and Laplace 's equations - Capacitance, Energy density.

Application Case Study: Electrostatic Discharge, Cathode Ray Oscilloscope.

Mapping of Course Outcomes for Unit I	CO1. Apply the basic electromagnetic principles and determine the fields (E & H) due to the given source.

Unit II	Magneto statics	(08 Hrs.)

Lorentz force, magnetic field intensity (H), Magnetic Flux Density(B), – Biot–Savart's Law – Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current,
Magnetization, magnetic materials, Boundary conditions for Magnetic Fields, Magnetic force, Torque.

Application Case Study: Lightning, Magnetic Resonance Imaging (MRI), RF MEMS, Magnetic Levitation, Electromagnetic Pump.

Mapping of Course Outcomes for Unit II	CO2: Apply boundary conditions to the boundaries between various media to interpret behavior of the fields either sides.

Unit III	Maxwell's Equations	(08 Hrs.)
Maxwell's Equations: Integral and differential forms of Maxwell's equations, Physical significance of each equation, Applications of Maxwell's equations in engineering. Electromagnetic Wave Propagation: Wave equation derivation from Maxwell's equations, Time varying Maxwell's equations - point form, integral form, Power and Pointing theorem, concept of Retarded magnetic vector potential, Snell's law. **Application Case Study:** Memristor, Electric Motors, Generators.		
Mapping of Course Outcomes for Unit III	**CO3: State, Identify and Apply Maxwell's equations (integral and differential forms) in both the forms (Static, time-varying or Time-harmonic field) for various sources**	

Unit IV	Electromagnetic Field Effects in VLSI Circuits	(08 Hrs.)
Capacitive and Inductive Coupling in VLSI: Parasitic capacitance and inductance in VLSI interconnects, Impact of interconnect delay and crosstalk on signal integrity, Methods to mitigate parasitic effects. **Electromagnetic Field Effects on High-Speed Circuit Design**: Effects of electromagnetic fields on signal integrity in high-speed circuits, Techniques for designing low-noise and high-performance circuits.		
Mapping of Course Outcomes for Unit IV	**CO4: Possess the skills to analyze the effects of parasitic capacitance and inductance in VLSI circuits**	

Unit V	Introduction to RF Circuits	(08 Hrs.)
Overview of RF Circuit Design: Frequency spectrum and RF communications, Role of CMOS technology in RF circuit design, Challenges and advantages of CMOS in RF circuits. CMOS Transistors in RF Applications: High-frequency behavior of CMOS transistors, Transistor models for RF applications, Biasing, matching, and noise considerations for RF CMOS circuits. RF Amplifiers and Oscillators: CMOS RF amplifiers: Common-source, common-gate, and cascade configurations, Design of low-noise amplifiers (LNAs) and power amplifiers, Oscillator design: Ring oscillators, LC oscillators, and phase-locked loops (PLLs).		
Mapping of Course Outcomes for Unit V	**CO5: Design and analyze RF CMOS circuits, including amplifiers, oscillators, and mixers**	

Unit VI	Advanced RF CMOS Circuit Design	(08Hrs.)
CMOS-based Radio Frequency Filters: Design of low-pass, high-pass, band-pass, and band-stop filters, Synthesis and implementation of RF filters in CMOS.**CMOS Mixers and Frequency Synthesizers:** Basic principles of RF mixers and their operation, CMOS mixer architectures and design techniques, Frequency synthesis and PLLs in CMOS-based RF circuits. **Design Considerations and Optimization:** Power consumption, linearity, and noise figure in RF CMOS circuits, Design optimization for low-cost and high-performance RF systems, Challenges in integrating RF circuits with digital CMOS systems.		
Mapping of Course Outcomes for Unit VI	**CO6: Design RF CMOS Circuit**	

Learning Resources

Text Books:

1) M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", Oxford University Press, India, 2015 (Asian adaptation of 'M.N.O. Sadiku, Elements of Electromagnetics, Sixth International Edition, Oxford University Press'), 6th Edition
2) William H. Hayt and John A. Buck, "Engineering Electromagnetics, Tata McGraw Hill, 8th Revised Edition.
3) Microwave Engineering by David M. Pozar.
4) Electromagnetic Waves and Antennas by Sophocles J. Orfanidis.
5) RF Microelectronics by Behzad Razavi.
6) CMOS Analog Circuit Design by Philip E. Allen and Douglas R. Holberg.

Reference Books:

1. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5th Edition.
2. Jordan and Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 1964.

MOOC / NPTEL Courses:

1. NPTEL Course "Transmission Lines and EM Waves -Video course" Prof. R.K. Shevgaonkar Link of the Course: https://nptel.ac.in/courses/117/101/117101056/
2. NPTEL Course on "Electromagnetic theory - Video course" Dr. Pradeep Kumar K Link of the Course: https://nptel.ac.in/courses/108/104/108104087/
3. David Staelin. 6.013 Electromagnetics and Applications. Spring 2009. Massachusetts Institute of Technology: MIT Open Course Ware

   Link:https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-013-electromagnetics-and-applications-spring-2009/index.html.

List of Tutorials	
1.	**Vector Field Analysis** Derive expressions for electric and magnetic fields in various configurations
2.	**Maxwell's Equations** Derive the wave equation from Maxwell's equations
3	Electric & Magnetic Boundary Conditions **Derive** expressions for electric and magnetic fields in various boundary conditions
4	**Parasitic Capacitance and Inductance in VLSI** Calculate parasitic capacitance between different metal layers in a VLSI chip
5	**Electromagnetic Interference (EMI) and Shielding** Design a simple shielded structure to reduce EMI in a VLSI environment. Analyze and optimize the design for minimal EMI using simulation tools
6.	**CMOS RF Amplifier Design** Design a CMOS-based low-noise amplifier (LNA) using a common-source configuration Analyze the trade-offs between power consumption and performance
7.	**CMOS Mixer Design and Analysis** Design a simple CMOS mixer, Analyze the mixer's response to various input signals and frequency bands
8.	**RF Filter Design in CMOS Technology** Design a band-pass filter for an RF application and optimize the design for size and performance.
9	**CMOS-based Frequency Synthesizer Design** Design a phase-locked loop (PLL) based frequency synthesizer Analyze and optimize the synthesizer's performance for RF applications.
10	**CMOS RF Circuits** Design a simple CMOS RF transceiver incorporating an LNA, mixer, filter, and synthesizer

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304193: Project Management

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any: NIL

Companion Course, if any: NIL

Course Objectives: To make the students understand

- The basics of project management and its life cycle
- The process of project identification, selection criteria of the project and how the project planning is undertaken.
- The organizational structure within a project and issues related to project management
- The techniques for effective project scheduling and resource considerations in project.
- The basics of effective handling the risks as well as managing finances within the project
- The complete product development process and requirements for entrepreneurship along with related legal issues.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Apply the fundamental knowledge of project management for effectively handling the projects.
CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.
CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.
CO4: Apply the project scheduling techniques to create a Project Schedule Plan and accordingly utilize the resources to meet the project deadline.
CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.
CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.

Course Contents

Unit I	Fundamentals of Project Management	(06 Hrs.)
Basics of Project Management: Definition of Project, The Project Life Cycle, Definition of project management, Need of Project management, Project Management process and its importance, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles.		
Mapping of Course Outcomes for Unit I	**CO1: Apply the fundamental knowledge of project management for effectively handling the projects.**	

Unit II	Project Identification, Selection & Planning	(06 Hrs.)
Project Identification and Selection: Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. **Project Planning:** Introduction and need for Project Planning, Project Life Cycle, Roles, Responsibility and Team Work, Project Planning Process, Work Breakdown Structure (WBS)		
Mapping of Course Outcomes for Unit II	**CO2: Identify and select the appropriate project based on feasibility study and undertake its effective planning.**	

Unit III	Project Organizational structure & Issues	(07 Hrs.)
Organizational Structure and Organizational Issues: Introduction, Concept of Organizational Structure, Roles and Responsibilities of Project Leader, Relationship between Project Manager and Line Manager, Leadership Styles for Project Managers, Conflict Resolution, Team Management and Diversity Management, Change management		
Mapping of Course Outcomes for Unit III	**CO3: Assimilate effectively within the organizational structure of project and handle project management related issues in an efficient manner.**	

Unit IV	Project Scheduling	(07 Hrs.)
PERT and CPM: Introduction, Development of Project Network, Time Estimation, Determination of the Critical Path, PERT Model, Measures of variability, CPM Model, Network Cost System **Resources Considerations in Projects:** Introduction, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, Cost Forecasts		
Mapping of Course Outcomes for Unit IV	**CO4: Apply the project scheduling techniques to create a Project Schedule plan and accordingly utilize the resources to meet the project deadline.**	

Unit V	Project Risk & Financial Management	(08 Hrs.)
Project Risk Management: Introduction, Risk, Risk Management, Role of Risk Management in Overall Project Management, steps in Risk Management, Risk Identification, Risk Analysis, Reducing Risks **Introduction to Project Management Tools** such as: Trello, JIRA and Asana. **Financial Management in Projects:** Project Finance structure, Process of Project Financial Management: Conducting Feasibility Studies, Planning the Project Finance, Arranging the Financial Package, Controlling the Financial Package, Controlling Financial Risk, Options Models.		
Mapping of Course Outcomes for Unit V	**CO5: Identify and assess the project risks and manage finances in line with Project Financial Management Process.**	

Unit VI	Product Development & Entrepreneurship	(08 Hrs.)
Product Development: Introduction, Development Process and organizations, product planning, identifying customer needs, Product Significations, concept generation, selection, testing, Design for Manufacturing, Prototyping, Robust Design **Entrepreneurship:** Concept, knowledge, and skills requirement; characteristic of successful entrepreneurs; entrepreneurship process; factors impacting emergence of entrepreneurship **Legal issues related to Product development and Entrepreneurship:** Intellectual property rights- patents, trademarks, copyrights, trade secrets, licensing, franchising.		
Mapping of Course Outcomes for Unit VI	**CO6: Develop new products assessing their commercial viability and develop skillsets for becoming successful entrepreneurs while being fully aware of the legal issues related to Product development and Entrepreneurship.**	

Learning Resources

Text Books:

1. H.Kerzer, “Project Management: A Systems Approach to Planning, Scheduling, and Controlling”, John Wiley & Sons, Inc., 10th Edition, 2009.
2. Chandra, P., “Projects”, Tata McGraw-Hill Education, 8th Edition, 2009.

Reference Books:

1. Morris, P. W. G. and Pinto, J. K., "The Wiley Guide to Managing Projects", JohnWiley & Sons, 2004.
2. Karl Ulrich, Steven Eppinger, "Product Design and Development", McGraw Hill / Irvin, 3rd Edition 2009.
3. R. Majumdar, "Product Management in India", PHI, 2nd Edition, 2010.
4. G.S. Batra, "Development of Entrepreneurship", Deep and Deep publications, New Delhi.
5. Christine Petersen, "The Practical Guide to Project Management", PMP,1st Edition, 2013.
6. Russell W. Darnall, John M. Preston, "Project Management from Simple to Complex", The Saylor Foundation.
7. Levy, F. K. and Wiest, J. D., "A Management Guide to PERT/CPM", Prentice Hall, 2nd Edition, 1969.
8. Lewis, R., "Project Management: Strategic Design and Implementation", McGraw-Hill, 5th Edition. 2006.
9. Venkataraman. R., J.K. Pinto, "Cost and Value Management in Projects", John Wiley & sons.

MOOC / NPTEL Courses:

1. NPTEL Course **"Project Management for Managers"**

   Link of the Course: **https://nptel.ac.in/courses/110/107/110107081/**

2. NPTEL Course on **"Intellectual Property Rights and Competition Law"**

   Link of the Course: **https://nptel.ac.in/courses/110/105/110105139/**

List of Tutorials to be carried out

1.	Understanding Impact of Delays in Project Completions with a company's case study.
2.	Designing a Work Breakdown Structure (WBS) for any sample project.
3.	Case study on Conflict Resolution and understanding its challenges.
4.	Solve examples on Project scheduling using CPM and PERT Model.
5.	Assignment on Risk Identification and Risk Analysis with a company's example and/ or exploration of various project management tools.
6.	Prepare a Business plan for an sample Product/ Service to be launched.

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304409: Embedded Processors

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Digital Systems
2. Microcontrollers

Companion Course, if any: Embedded Processors Lab

Course Objectives:

- To make the students aware of the need of Embedded C and programming in Embedded C.
- To get the students acquainted with the need and applications of ARM Microprocessors in Embedded systems.
- To get insight of architecture and features of ARM 7 and ARM CORTEX M4 microcontroller.
- To enhance the capabilities of students to interface of various I/O devices, sensors and communication devices.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Understand basics of Embedded C Programming and usage of Embedded C and study different software tools for programming microcontrollers.

CO2: Get acquainted with various Embedded Processor architectures related to industrial application.

CO3: Know about the programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.

CO4: Understand the architectures of ARM Cortex M4 Microcontrollers and its advantages over ARM 7 Microcontrollers.

CO5: Implement the real world programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.

CO6: Recognize the interfacing of real world sensors and standard buses. Will also able to design different casestudies.

Course Contents

Unit I	Embedded Processor Fundamentals	(06 Hrs.)

Programming in Embedded C: Using C for Embedded C, data types, storage class, operators, Branching: if, else-if, Looping: for, while, do-while.

Embedded System Development Environment: IDE (Introduction) types of file generated on cross-compilation, assembler, disassembler, Simulators and Debuggers.

Embedded System definition, Embedded Processor definition and classification, The RISC and CISC, von Neumann and Harvard Architecture, ARM processors and its versions, features of ARM Processor Families:ARM7, ARM9 & ARM11, ARM Design Philosophy.

Mapping of Course Outcomes for Unit I	CO1: To understand basics of Embedded C Programming and usage of Embedded C and study different software tools for programming microcontrollers.

Unit II	ARM7 Based Microcontroller	(08 Hrs.)

ARM core data flow model, Programmers model, Registers, CPSR and SPSR, Processor modes, ARM Nomenclature.

LPC2148: Features, Block Diagram and Description, System Control Block, Memory Map, System Control Block (PLL and VPB divider), Pin Connect Block, GPIO, Timer Block for Delay Generation, LPC 2148 Interfacing with LED, Switches, Relay, Interfacing LCD and keypad.

Mapping of Course Outcomes for Unit II	CO2: To get acquainted with various Embedded Processor architectures related to industrial application.

Unit III	Real World Interfacing with ARM7 Based Microcontroller	(06 Hrs.)

UART Programming for transmission and reception of characters, Interfacing the peripherals to LPC2148: GSM and GPS using UART, on-chip ADC using interrupt (VIC), EEPROM using I2C, on-chip DAC for waveform generation, Interfacing with ARM 7 with DHT 11 sensor and servomotor.

Mapping of Course Outcomes for Unit III	CO3: To Know about the programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.

Unit IV	Introduction to ARM CORTEX M4 Based Microcontroller	(08 Hrs.)
Introduction to ARM CORTEX series: CORTEX A, R, M processors**,** Firmware development using CMSIS Standard. Introduction to ARM CORTEX M4 microprocessor core, programmer model, Processor Modes, Memory Map, Introduction Arm Cortex-M cores, STM32F4xx Architecture, ARM STM Bus Architecture, STM32F4xx Clock and SYSCLK, Peripheral Clock, PLL clock, Interrupts and Exceptions in STM32F4xx.		
Mapping of Course Outcomes for Unit IV	**CO4: To understand the architectures of ARM Cortex M4 Microcontrollers and its advantages over ARM 7 Microcontrollers.**	

Unit V	Real World Interfacing with Cortex M4 Based Microcontroller	(06 Hrs.)
GPIO Programming, Interfacing seven segment LED, LDR and MQ3 sensor with STM32F4xx, STM32F4xx: Counters and Timers: Timer and Delay Generation, UART Programming, on chip ADC and On-chip DAC for waveform generation.		
Mapping of Course Outcomes for Unit V	**CO5: Implement the real world programming of ARM 7 based microcontroller with on chip peripherals and external peripherals.**	

Unit VI	Case Studies with Cortex M Based Microcontroller	(06 Hrs.)
STM32F4xx Interfacing with accelerometer MPU 6050, Ultrasonic Sensor HC-SR04, PWM: Controlling speed and direction of DC Motor CAN Bus: Features, CAN Frame, sequence of transmitting and receiving data on CAN Bus.		
Mapping of Course Outcomes for Unit VI	**CO6: To become aware of the interfacing of real world sensors and standard buses. Will also able to develop embedded application using different case studies.**	

Learning Resources

Text Books:

1. K.V. Shibu, “Introduction to Embedded Systems”, McGraw Hill Education India Private Limited, 2nd Edition
2. Andrew Sloss, Dominic Symes, Chris Wright, “ARM System Developer’s Guide – Designing and Optimizing System Software”, Elsevier, 1st Edition.
3. Shujen Chen, Muhammad Ali Mazidi, Eshragh Ghaemi, “STM32 Arm Programming for EmbeddedSystems: Using C Language with STM32”, Nucleo, Micro DigitalEd., Illustrated Edition,2018.

Reference Books:

1. UM10139 LPC214x User manual, NXP Semiconductor
2. RM0390 Reference manual, STM32F446xx advanced Arm®-based 32-bit MCUs
3. Joseph Yiu, "The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors", Newnes, 3rd Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"ARM Based Development"**, video course

   Link of the Course: **https://nptel.ac.in/courses/117/106/117106111/**

2. NPTEL Course on **" Embedded System Design with ARM", video course**

   Link of the Course: **https://nptel.ac.in/courses/106/105/106105193/**

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

304410-A: Fundamentals of JAVA Programming (Elective - II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. Data Structures

2. Object Oriented Programming concept

Companion Course, if any: Fundamentals of JAVA Programming Lab

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in Java.
- Develop an ability to write various programs in Java for problem solving.

Course Outcomes: On completion of the course, learner will be able to –

CO1: Understand the basic principles of Java programming language

CO2: Apply the concepts of classes and objects to write programs in Java

CO3: Demonstrate the concepts of methods & Inheritance

CO4: Use the concepts of interfaces & packages for program implementation

CO5: Understand multithreading and Exception handling in Java to develop robust programs

CO6: Use Graphics class, AWT packages and manage input and output files in Java

Course Contents

Unit I	JAVA Fundamentals	(08 Hrs.)

Review of Object oriented concepts, Evolution of Java, Comparison of Java with other programming languages, Java features, Java and World Wide Web, Java Run Time Environment. JVM architecture. Overview of Java Language, Simple Java Program, Java Program Structure. Installing and Configuring Java.

Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & looping.

Mapping of Course Outcomes for Unit I	CO1: Understand the basic principles of Java programming language.

Unit II	Classes and Objects	(06 Hrs.)
Class Fundamentals, Creating Objects, Accessing Class members, Assigning Object reference variables, Methods, Constructors, using objects as parameters, Argument passing, returning objects, Method Overloading, static members, Nesting of Methods, this keyword, Garbage collection, finalize methods, final variables and methods, final class.		
Mapping of Course Outcomes for Unit II	**CO2: Apply the concepts of classes and objects to write programs in Java**	

Unit III	Methods & Inheritance in JAVA	(06 Hrs.)
Abstract Methods and classes, Strings, One dimensional and two dimensional arrays, wrapper classes, enumerated types, Command line arguments **Inheritance:** Inheritance in Java, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch.		
Mapping of Course Outcomes for Unit III	**CO3: Demonstrate the concepts of methods & Inheritance.**	

Unit IV	Interfaces & Packages	(06 Hrs.)
Interfaces: Define, implement and extend, Accessing Interface variables, Default interface methods, Using static method in interface **Packages:** Java API Packages, Using System Packages, Creating accessing and using a package, Importing packages, Adding a class to a Package, Hiding classes.		
Mapping of Course Outcomes for Unit IV	**CO4: Use the concept of interfaces & packages for program implementation.**	

Unit V	Multithreading & Exception Handling	(06 Hrs.)
Introduction to multithreading: Introduction, creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, reading console inputs, Writing Console output. Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.		
Mapping of Course Outcomes for Unit V	**CO5: Understand multithreading and Exception handling in Java to develop robust programs**	

Unit VI	Graphics Programming and File Handling	(06 Hrs.)
Graphics class, Introduction to AWT packages, Handling events on AWT components, Introduction to Swing package, components and containers. **Managing input/output files**: Concept of streams, Stream Classes, Byte stream, Character stream, Using Stream, creation of files, reading or writing characters / bytes, Concatenating and buffering files, Random access files.		
Mapping of Course Outcomes for Unit VI	**CO6: Use Graphics class, AWT packages and manage input and output files in Java**	

Learning Resources

Text Books:

1. E Balagurusamy, "Programming with JAVA", Tata McGraw Hill, 6th Edition.
2. Herbert Schildt, "Java: The complete reference", Tata McGraw Hill, 7th Edition.

Reference Books:

1. T. Budd, "Understanding OOP with Java", Pearson Education, 2nd Updated Edition.
2. Y. Daniel Liang (2010), "Introduction to Java programming", Pearson Education, India, 7th Edition.
3. Cay Horstmann , "Core Java Volume 1", Kindle, 11th Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Programming in Java"**

Link of the Course: https://nptel.ac.in/courses/106/105/106105191/

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304410-B: ASIC DESIGN-Elective II

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

1. VERILOG/ VHDL
2. DIGITAL CMOS
3. DIGITAL ELECTRONICS

SEMICONDUCTOR THEORY

Companion Course, if any:

COURSE OBJECTIVE:

1. To explain fundamentals of ASIC and SoC Design.
2. To introduce design flow of physical IC design.
3. Identify the issues at various stages of VLSI physical design.
4. To explore low power design techniques.
5. To make them comfortable with industry based case study.

COURSE OUTCOMES:

After completion of the course, students will be able to

1. Describe design flow, components of ASIC and SoC Design
2. Analyze the techniques and algorithms for floor planning, routing and placement of cells in physical IC Design.
3. Analyze clock tree synthesis and timing constraints
4. Describe low power design techniques and algorithms.
5. Learn ASIC Construction and testing techniques

Course Contents

Unit I	Introduction to ASIC	(08 Hrs.)

ASIC Modelling and Synthesis: IC Design Technologies, Types of ASIC and Comparisons, Full custom, Semi-custom and Programmable ASICs, Gate array-based ASIC, Channeled gate array, Channel less gate array, Structured gate array, Programmable logic devices-FPGA, ASIC Design flow, ASIC cell libraries, Logic Synthesis, Simulation, EDA Tools, HDL Based logic Design and Test bench, library, logic level optimization.

Mapping of Course Outcomes for Unit I	CO1: To explain fundamentals of ASIC and SoC Design.

Unit II	System-On-Chip Design	(08 Hrs.)

CMOS Logic:

Data path Logic Cells: Data Path Elements, Adders: Carry skip, Carry bypass, Carry save, Carry select, Conditional sum, Multiplier (Booth encoding), Data path Operators, I/O cells, Cell Compilers.

SOC-DESIGN:

SoC Design Flow, Platform-based and IP based SoC Designs, Basic Concepts of Bus-Based Communication Architectures, On-Chip Communication Architecture Standards, Low-Power SoC Design

Mapping of Course Outcomes for Unit II	CO2: To introduce design flow of physical IC design.

Unit III	Partitioning, Floor planning and Placement	(08 Hrs.)

Introduction, partitioning at different levels, partitioning techniques: constructive and iterative improvement, Floor planning and Placement : Floor-planning and placement differences, Design style specific issues, Floor planning and placement algorithms

Mapping of Course Outcomes for Unit III	CO3: Identify the issues at various stages of VLSI physical design.

Unit IV	Routing and Clocking	(08 Hrs.)

Routing: Introduction, Types of Routing, Grid Routing, Global Routing, Detailed Routing, Power and Ground Routing, Interconnect Modeling and Layout Compaction, Clock Design**,** Clock Routing**,** Static Timing Analysis and Timing Closure.

Mapping of Course Outcomes for Unit IV	CO4: To make them comfortable with industry based case study.

Unit V	Low Power Design techniques	(08 Hrs.)
Techniques to reduce dynamic power and static power, clock gating, supply voltage reduction, leakage reduction techniques, gate level design for low power, architecture level techniques for low power, and algorithmic level techniques for low power.		
Mapping of Course Outcomes for Unit V	**CO5: To explore low power design techniques.**	

Unit VI	Physical Design of a Digital Block	(08 Hrs.)
Netlist to CIF: Overview of the complete physical design flow, Floor planning and power grid design, Placement and optimization of standard cells, Clock Tree Synthesis (CTS) and buffering, Routing (global and detailed) with congestion analysis, Foundry design rules, Parasitic extraction and timing analysis, Power analysis (short circuit current drop, dynamic/static power)		
Mapping of Course Outcomes for Unit VI	**CO6: To make them comfortable with industry based case study.**	

Learning Resources

Text Books:

M.J.S. Smith, **"Application Specific Integrated Circuits"**,Pearson, (2003).

D. Gajski, S. Abdi, A. Gerstlauer, G. Schirner, **"Embedded System Design: Modeling, Synthesis and Verification"** Springer, (2009).

S.Pasricha and N.Dutt, **"On-Chip Communication Architectures System on Chip Interconnect"**, Morgan Kaufmann,(2008).

Reference Books:

H.Gerez, **"Algorithms for VLSI Design Automation"**, John Wiley, (1998).

J..M.Rabaey, A. Chandrakasan and B.Nikolic, **"Digital Integrated Circuit Design Perspective"**, PHI, (2nd Edition), (2003).

D. A.Hodges, **"Analysis and Design of Digital Integrated Circuits"**, McGraw-Hill Higher Education, (3rd Edition),(2004).

Hoi-Jun Yoo, Kangmin Leeand Jun Kyong Kim, **"Low-Power NoC for High-Performance SoC Design"**, CRC Press, (1st Edition), (2008).

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

304410-C: Machine Learning – (Elective II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses : Data Science and Big Data Analytics

Course Objectives:

- To understand the need for Machine learning.
- To explore various data pre-processing methods.
- To study and understand classification methods.
- To learn the working of clustering algorithms.

Course Outcomes: On completion of the course, student will be able to–

CO1: Understand the fundamental concepts of Machine Learning.

CO2: Identify the needs and challenges of machine learning for real time applications.

CO3: Apply various data pre-processing techniques to simplify and speed up machine learning algorithms.

CO4: Apply various feature selection and statistical feature engineering techniques to construct effective feature representations for Machine Learning models.

CO5: Select and apply appropriately supervised machine learning algorithms and classifiers for real time applications.

CO6: Compare and contrast different clustering algorithms.

Course Contents

Unit I	Introduction to Machine Learning	(06 Hrs.)
Introduction to Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. Types of learning: Supervised, Unsupervised, and semi-supervised, reinforcement learning techniques.		
Mapping of Course Outcomes for Unit I	**CO1: Understand the fundamental concepts of Machine Learning**	

Unit II	Machine Learning Models	(06 Hrs.)
Models of Machine learning: Geometric model, Probabilistic Models, Logical Models, Grouping and grading models, Parametric and non-parametric models. Important Elements of Machine Learning- Data formats, Learnability, Statistical learning approaches		
Mapping of Course Outcomes for Unit II	**CO2:.Identify the needs and challenges of machine learning for real time applications.**	

Unit III	Introduction of Feature Engineering	(06 Hrs.)
Concept of Feature, Preprocessing of data: Normalization and Scaling, Standardization, Managing missing values, Introduction to Dimensionality Reduction, Principal Component Analysis (PCA), Feature Extraction: Kernel PCA, Local Binary Pattern.		
Mapping of Course Outcomes for Unit III	**CO3: Apply various data pre-processing techniques to simplify and speed up machine learning algorithms.**	

Unit IV	Feature Selection Techniques	(08 Hrs.)
Introduction to various Feature Selection Techniques, Sequential Forward Selection, Sequential Backward Selection. Statistical feature engineering: count-based, Length, Mean, Median, Mode etc. based feature vector creation. Multidimensional Scaling, Matrix Factorization Techniques.		
Mapping of Course Outcomes for Unit IV	**CO4: Apply various feature selection and statistical feature engineering techniques to construct effective feature representations for Machine Learning models.**	

Unit V	Supervised Learning: Regression & Classification	(08 Hrs.)
Bias, Variance, Generalization, Under fitting, Overfitting, Linear regression, Regression: Lasso regression, Ridge regression, Gradient descent algorithm. Evaluation Metrics: MAE, RMSE, R2 **Classification:** K-nearest neighbor, Support vector machine. Ensemble Learning: Bagging, Boosting, Random Forest, Ad boost.		

Mapping of Course Outcomes for Unit V	**CO5: Select and apply appropriately supervised machine learning algorithms and classifiers for real time applications.**

Unit VI	**Unsupervised Learning**	**(08 Hrs.)**

K-Means, K-medoids, Hierarchical, and Density-based Clustering, Spectral Clustering. Outlier analysis: introduction of isolation factor, local outlier factor. Evaluation metrics and score: elbow method, extrinsic and intrinsic methods

Mapping of Course Outcomes for Unit VI	**CO6: Compare and contrast different clustering algorithms.**

Learning Resources

Text Books:

1. Bishop, Christopher M., and Nasser M. Nasrabadi, "Pattern recognition and machine learning",Vol. 4.No. 4. New York: springer, 2006.
2. Ethem Alpaydin, " Introduction to Machine Learning", PHI 2nd Edition-2013

Reference Books:

1. Tom Mitchell, " Machine learning", McGraw-Hill series in Computer Science, 1997
2. Shalev-Shwartz, Shai, and Shai Ben-David, "Understanding machine learning: From theory to algorithms", Cambridge university press, 2014.
3. Jiawei Han, Micheline Kamber, and Jian Pie, "Data Mining: Concepts and Techniques", Elsevier Publishers Third Edition, ISBN: 9780123814791,9780123814807
4. Hastie, Trevor, et al., "The elements of statistical learning: data mining, inference, and prediction", Vol. 2. New York: springer, 2009.
5. McKinney, "Python for Data Analysis ",O' Reilly media, ISBN : 978-1-449-31979-3
6. Trent hauk, "Scikit-learn", Cookbook , Packt Publishing, ISBN: 9781787286382
7. Goodfellow I.,Bengio Y. and Courville, " A Deep Learning", MIT Press, 2016

e-Books:

1. Python Machine Learning : http://www.ru.ac.bd/wp-content/uploads/sites/25/2019/03/207_05_01_Rajchka_Using-Python-for-machine- learning-2015.pdf
2. Foundation of Machine Learning: https://cs.nyu.edu/~mohri/mlbook/
3. Dive into Deep Learning: http://d2l.ai/
4. A brief introduction to machine learning for Engineers: https://arxiv.org/pdf/1709.02840.pdf
5. Feature selection: https://dl.acm.org/doi/pdf/10.5555/944919.944968
6. Introductory Machine Learning Nodes : http://lcsl.mit.edu/courses/ml/1718/MLNotes.pdf

MOOC Courses Links:

Introduction to Machine Learning : https://nptel.ac.in/courses/106105152

Introduction to Machine Learning (IIT Madras):

https://onlinecourses.nptel.ac.in/noc22_cs29/prevew

Deep learning: https://nptel.ac.in/courses/106106184

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304410-D: Network Security (Elective-II)

Teaching Scheme:	Credit	Examination Scheme:
Theory: 03 Hrs. / week	03	In-Sem (Theory): 30 Marks End Sem (Theory): 70 Marks

Prerequisite Courses, if any:

Companion Course, if any:

Course Objectives: To introduce various network models, security threats and attacks and fundamentals of network security.

- To imbibe good foundation of network security in students for implementation of new network security algorithms.
- To understand different network models and the protocols used in each layer.
- To acquire detailed approach of encryption decryption for the data to transmit.
- To understand the role of network security as a tool for protection of different network entities.
- To be able to accurately apply security algorithms to real world security issues.
- To ensure windows and web browser security through implementation of various encryption standards.

Course Outcomes: On completion of the course, learner will be able to -

CO1: Analyze attacks on computers and computer security.
CO2: Demonstrate knowledge of cryptography techniques.
CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers
CO4: Evaluate different Message Authentication Algorithms and Hash Functions
CO5: Get acquainted with various aspects of E-Mail Security
CO6: Assimilate various aspects of Web Security

Course Contents

Unit I	Attacks on Computers and Computer Security	(06 Hrs.)

Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks, Security services, Security Mechanisms, A model for Network Security

Mapping of Course Outcomes for Unit I	CO1: Analyze attacks on computers and computer security.

Unit II	Cryptography-Concepts and Techniques	(06 Hrs.)
Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, stenography, key range and key size, possible types ofattacks.		
Mapping of Course Outcomes for Unit II	**CO2: Demonstrate knowledge of cryptography techniques.**	

Unit III	Symmetric and Asymmetric key for Ciphers	(08 Hrs.)
Block Cipher principles & Algorithms (DES, AES, Blowfish), Differential and Linear Crypt analysis, Block cipher modes of operation, Stream ciphers, RC4, Location and placement of encryption function, Key distribution, Asymmetric key Ciphers, Principles of public key crypto systems, Algorithms (RSA, Diffie-Hellman, ECC), Key Distribution.		
Mapping of Course Outcomes for Unit III	**CO3: Illustrate various Symmetric and Asymmetric keys for Ciphers.**	

Unit IV	Message Authentication Algorithms and Hash Functions	(07 Hrs.)
Authentication requirements, Functions, Message authentication codes, Hash Functions, Secure hash algorithm, HMAC, CMAC, Digital signatures, knapsack algorithm, Authentication Applications such as Kerberos, X.509 Authentication Service, Public – Key Infrastructure, Biometric Authentication.		
Mapping of Course Outcomes for Unit IV	**CO4: Evaluate different Message Authentication Algorithms and Hash Functions.**	

Unit V	E-Mail Security	(06 Hrs.)
Pretty Good Privacy, S/MIME, IP security overview, IP Security architecture, Authentication Header, Encapsulating , Security payload, Combining security associations, Key management		
Mapping of Course Outcomes for Unit V	**CO5: Get acquainted with various aspects of E-Mail Security**	

Unit VI	Web Security	(07 Hrs.)
Web security considerations, Secure Socket Layer and Transport Layer Security, Secure electronic transaction, Intruders, Intrusion detection, password management, virus and related threats, Countermeasures, Firewall design principles, types of firewalls, Secure Inter-branch Payment Transactions, Cross site Scripting Vulnerability, Virtual E lections.		
Mapping of Course Outcomes for Unit VI	**CO6**: Assimilate various aspects of Web Security	

Learning Resources

Text Books:

1. William Stallings , "Cryptography and Network Security" ,Pearson Education, 4th Edition
2. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 3rd Edition.
3. C K Shymala, N Harini, Dr. T R Padmanabhan, "Cryptography and Network Security", Wiley India,1st Edition.

Reference Books:

1. Forouzan Mukhopadhyay, "Cryptography and Network Security", Mc Graw Hill, 2nd Edition.
2. Mark Stamp, "Information Security, Principles and Practice", Wiley India, 2nd Edition.
3. W.M. Arthur Conklin, Greg White, "Principles of Computer Security", TMH, 4th Edition.
4. Neal Krawetz, "Introduction to Network Security", CENGAGE Learning Distributor, 1st Edition.
5. Bernard Menezes, "Network Security and Cryptography", CENGAGE Learning Distributor, 1st Edition.

MOOC / NPTEL Courses:

1. NPTEL Course **"Introduction to Cyber Security "**

Link of the Course: https://onlinecourses.swayam2.ac.in/nou19_cs08/preview

2. NPTEL Course "**Information Security – 5 – Secure Systems Engineering**"

Link of the Course: https://nptel.ac.in/courses/106/106/106106199/

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304411: Embedded Processors Lab

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Practical: 50 Marks

Prerequisite Courses, if any: -

Companion Course, if any: Embedded Processors

List of Laboratory Experiments

	Group A (Any Three)
1.	Interfacing 16 X 2-character LCD display and Keypad with ARM LPC 2148 Microcontroller to display the key pressed.
2.	Write embedded C program to use timer block of LPC 2148 along with Switches to generate suitable delay to toggle LEDs.
3.	To generate different waveforms using on-chip DAC for LPC 2148.
4.	Use on-chip ADC to read the analog value and display digital value on LCD for LPC 2148.
5.	Interfacing GPS with UART using LPC 2148
	Group B (Any Three)
6.	Interfacing Seven Segment LED using STM32F4xx
7.	Write embedded C program to Transmit a character from keyboard using on chip UART for STM32F4xx.
8.	Write embedded C program to on chip ADC implementation with STM32F4xx
9.	To control speed and direction of DC Motor using PWM Block for STM32F4xx.
	Group B (Any Two)
10.	Interfacing DHT11 with LPC2148.
11.	Interfacing accelerometer cum Gyroscope MPU 6050 with STM32F4xx.
12.	Interfacing Ultrasonic Sensor HC-SR04 with STM32F4xx.
13.	Interfacing LDR and MQ3 sensor with STM32F4xx

Virtual LAB Links:

Link of the Virtual Lab: http: // vlabs.iikgp.ernet.in/rtes/

Note: Additional 2 experiments to be performed using the virtual lab

Savitribai Phule Pune University Third Year of Electronics Engineering VLSI and Design Technology (2019 Course) 304412: System Verilog Lab		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / week	**01**	**Practical: 50 Marks**
Prerequisite Courses, if any: -Verilog programming		
Companion Course, if any: - 204204, 204206		

List of Laboratory Experiments	
1.	Study the basic building blocks of System Verilog for Verification of Code
2.	Write a program and simulate using EDA Playground illustrating the conditional statements in System Verilog
3.	a) Study Different types of array in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of array statements in System Verilog
4.	a) Study Different types of function in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of functions in System Verilog
5.	a) Study Different types of tasks in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of tasks in System Verilog
6.	a) Study Different types of fork join in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of processes in System Verilog
7.	a) Study Polymorphism and data Encapsulation in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of above features in System Verilog
8.	a) Study Different types of Case statements in System Verilog. b) Write a program and simulate using EDA Playground illustrating the use of cases in System Verilog
9.	Write a verification program and simulate using EDA Playground in System Verilog

All above assignments are compulsory.

Use appropriate FOSS like EDA playground.

Theory and related code can be taken from SV - VLSI Verify

One certificate course is mandatory for students based on system Verification.

https://www.udemy.com/course/system-verilog-for-chip-verification

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

30413-A: Fundamentals of JAVA Programming Lab (Elective - II)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Oral: 25 Marks

Prerequisite Courses, if any: - Knowledge of Object Oriented Programming

Companion Course, if any: Fundamentals of JAVA Programming

List of Laboratory Experiments

Group A (All are Compulsory)

1.	Write some simple programs in Java such as: i) To find factorial of number. ii) To display first 50 prime numbers. iii) To find sum and average of N numbers
2.	Write a program in Java to implement a Calculator with simple arithmetic operations such as add, subtract, multiply, divide, factorial etc. using switch case and other simple java statements. The objective of this assignment is to learn Constants, Variables, and Data Types, Operators and Expressions, Decision making statements in Java.
3.	Write a program in Java with class Rectangle with the data fields width, length, area and colour. The length, width and area are of double type and colour is of string type. The methods are get_length(), get_width(), get_colour() and find_area(). Create two objects of Rectangle and compare their area and colour. If the area and colour both are the same for the objects, then display " Matching Rectangles", otherwise display " Non-matching Rectangle"
4.	Write a program in JAVA to demonstrate the method and constructor overloading

Group B (Any Four)

5	Write Programs in Java to sort i) List of integers ii) List of names. The objective of this assignment is to learn Arrays and Strings in Java
6.	Write a Program in Java to add two matrices. The objective of this assignment is to learn Arrays in Java
7.	Write a program in Java to create a player class. Inherit the classes Cricket player, Football player and Hockey player from player class. The objective of this assignment is to learn the concepts of inheritance in Java.
8.	Write a Java program which imports user defined package and uses members of the classes contained in the package.
9.	Write a Java program which implements interface.
10.	Write a program to create multiple threads and demonstrate how two threads communicate with each other.

Group C (Any Three)	
11.	Write a java program which use try and catch for exception handling.
12.	Write a Java program to draw oval, rectangle, line , text using graphics class
13.	Write a java program in which data is read from one file and should be written in another file line by line.
14.	A Mini project in Java: A group of 4 students can develop a small application in Java

Virtual LAB Links:

Link of the Virtual Lab: https://java-iitd.vlabs.ac.in/

Note: Additional 2 experiments to be performed using the virtual labs.

Savitribai Phule Pune University

Third Year of Electronics Engineering

VLSI and Design Technology (2019 Course)

30413-B: ASIC DESIGN Lab (Elective – II)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Oral: 25 Marks

Prerequisite Courses, if any:

1. VERILOG/ VHDL
2. DIGITAL CMOS

Companion Course, if any:

List of Laboratory Experiments

PART A

Lab focuses on Verilog/VHDL design, synthesis, and simulation, targeting ASIC workflows, Power, LUTs, critical timings and delay estimations

1. Design , Synthesis and Simulation of 4-bit Adder (Ripple Carry)

2. Design , Synthesis and Simulation of RAM/ROM using Verilog/VHDL (behavioral modeling).

3. Design, Synthesis and Simulation of CMOS 2:1 mux using transmission gates

4. Design, Synthesis and Simulation of 4-bit **Parallel adders**

5. Design, Synthesis and Simulation of

- **a) 4-bit counters asynchronous up/down counter**
- **b) a) 4-bit counters synchronous counter**

PART B

6. Design, layout and implementation of CMOS Inverter, NAND and NOR

7. Design, layout and implementation of CMOS D-Latch

8. Design, layout and implementation of 1-bit RAM cell

9. Design, layout and implementation of Ring Oscillator

PART C

10. To design, simulate and estimate frequency response of common source, gate and drain amplifier

11. To design, simulate Mos based current mirror circuit and implement voltage-controlled oscillator

12. Analyze the performance of CMOS differential amplifier for various load

13. A mini project based on ASIC design flow

Savitribai Phule Pune University Third Year of Electronics Engineering VLSI and Design Technology (2019 Course) 30413-C: Machine Learning Lab (Elective – II)		
Teaching Scheme:	**Credit**	**Examination Scheme:**
Practical: 02 Hrs. / week	**01**	**Oral: 25 Marks**

List of Laboratory Experiments

Any 4 Experiments and 1 Mini project are mandatory.

1.	Predict the price of the Uber ride from a given pickup point to the agreed drop-off location. Perform following tasks: 1. Pre-process the dataset. 2. Identify outliers. 3. Check the correlation. 4. Implement linear regression and random forest regression models. 5. Evaluate the models and compare their respective scores like R2, RMSE, etc. Dataset link: https://www.kaggle.com/datasets/yasserh/uber-fares-dataset
2.	Classify the email using the binary classification method. Email Spam detection has two states: a) Normal State – Not Spam, b) Abnormal State – Spam. Use K-Nearest Neighbors and Support Vector Machine for classification. Analyze their performance. Dataset link: The emails.csv dataset on the Kaggle https://www.kaggle.com/datasets/balaka18/email-spam-classification-dataset-csv
3.	Implement Gradient Descent Algorithm to find the local minima of a function. For example, find the local minima of the function $y=(x+3)^2$ starting from the point x=2.
4.	Implement K-Nearest Neighbors algorithm on diabetes.csv dataset. Compute confusion matrix, accuracy, error rate, precision and recall on the given dataset. Dataset link : https://www.kaggle.com/datasets/abdallamahgoub/diabetes
5.	Implement K-Means clustering/ hierarchical clustering on sales_data_sample.csv dataset. Determine the number of clusters using the elbow method. Dataset link : https://www.kaggle.com/datasets/kyanyoga/sample-sales-data

Mini Projects

1	Mini Project - Use the following dataset to analyze ups and downs in the market and predict future stock price returns based on Indian Market data from 2000 to 2024. Dataset Link: https://www.kaggle.com/datasets/sagara9595/stock-data
2	Mini Project - Build a machine learning model that predicts the type of people who survived the Titanic shipwreck using passenger data (i.e. name, age, gender, socio-economic class, etc.). Dataset Link: https://www.kaggle.com/competitions/titanic/data
3	Mini Project - Develop a application for signature identification by creating your own dataset of your college student

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
30413-D : Network Security Lab (Elective – II)

Teaching Scheme:	Credit	Examination Scheme:
Practical: 02 Hrs. / week	01	Oral: 25 Marks

Prerequisite Courses, if any: -

Companion Course, if any: Network Security

	Group A (Any Three)
1.	Design and implement for the insecurity of default passwords, printed passwords and password transmitted in plain text.
2.	Write a program for Encryption and Decryption.
3.	Write a program to perform encryption and decryption using the following algorithms: Ceaser Cipher, Substitution Cipher http://vlabs.iitb.ac.in/bootcamp/labs/dbms/exp13/
4.	Write a program to implement digital Signature http://cse29-iiith.vlabs.ac.in/
	Group B (Any Two)
6.	Isolating WLAN traffic using separate firewall for VPN connection
7.	Study of different wireless network components and features of any one of the Mobile Security Apps
8.	Implementation of Symmetric and Asymmetric cryptography
9.	Implementation of Steganography
	Group C (Any Three)
10.	Implementation of DES http://cse29-iiith.vlabs.ac.in/
11.	Implementation of AES http://cse29-iiith.vlabs.ac.in/
12.	Implementation of Windows security using firewall and other tools
13.	Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
14.	Implementation of Hash functions http://cse29-iiith.vlabs.ac.in/

Virtual LAB Links:

Links of the Virtual Lab:

http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/Byte_Karma/index.html

Note: Additional 2 experiments to be performed using the virtual lab

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304414: Internship

Teaching Scheme:	Credit	Examination Scheme:
**	04	Term Work: 100 Marks

Course Objective:

- Will expose technical students to the industrial environment, which cannot be simulated in the classroom and hence creating competent professionals for the industry.
- Provide possible opportunities to learn, understand and sharpen the real time technical / managerial skills required at the job.
- Exposure to the current technological developments relevant to the subject area of training.
- Experience gained from the **'Internship'** will be used in classroom discussions.
- Create conditions conducive to quest for knowledge and its applicability on the job.
- Learn to apply the Technical knowledge in real industrial situations.
- Gain experience in writing Technical reports/projects.
- Expose students to the engineer's responsibilities and ethics.
- Familiarize with various materials, processes, products and their applications along with relevant aspects of quality control.
- Promote academic, professional and/or personal development.
- Expose the students to future employers.
- Understand the social, economic and administrative considerations that influence the working environment of industrial organizations.
- Understand the psychology of the workers and their habits, attitudes and approach to problem solving.

Course Outcomes:

On completion of the internship, learner will be able to –

CO1: To develop professional competence through internship.
CO2: To apply academic knowledge in a personal and professional environment.
CO3: To build the professional network and expose students to future employees.
CO4: Apply professional and societal ethics in their day to day life.
CO5: To become a responsible professional having social, economic and administrative considerations.
CO6: To make own career goals and personal aspirations.

Internships are educational and career development opportunities, providing practical experience in a field or discipline. Internships are far more important as the employers are looking for employees who are properly skilled and having awareness about industry environment,

practices and culture. Internship is structured, short-term, supervised training often focused around particular tasks or projects with defined time scales.

Core objective is to expose technical students to the industrial environment, which cannot be simulated/experienced in the classroom and hence creating competent professionals in the industry and to understand the social, economic and administrative considerations that influence the working environment of industrial organizations.

Engineering internships are intended to provide students with an opportunity to apply

theoretical knowledge from academics to the realities of the field work/training. The following guidelines are proposed to give academic credit for the internship undergone as a part of the Third Year Engineering curriculum.

A. Duration:

Internship to be completed after semester 5 and before commencement of semester 6 of at least 4 to 6 weeks; and it is to be assessed and evaluated in semester 6.

B. Framework of Internship:

- ✓ Students are required to be involved in Inter/ Intra Institutional Activities viz; Training with higher Institutions.
- ✓ Soft skill training organized by Training and Placement Cell of the respective institutions; contribution at incubation/ innovation /entrepreneurship cell of the institute; participation in conferences/ workshops/ competitions etc.
- ✓ Learning at Departmental Lab/ Tinkering Lab/ Institutional workshop.
- ✓ During the vacation after 5th semester, students are ready for industrial experience. Therefore, they may choose to undergo Internship / Innovation / Entrepreneurship related activities.
- ✓ Students may choose either to work on innovation or entrepreneurial activities resulting in start-up or undergo internship with industry/ NGO's/ Government organizations/ Micro/ Small/ Medium enterprises to make themselves ready for the industry.
- ✓ Every student is required to prepare a file containing documentary proofs of the activities done by him. The evaluation of these activities will be done by Programmed Head / Cell In- charge / Project Head / TPO / faculty mentor or Industry Supervisor.

C. Internship Guidelines:

a) Guidelines to the Institute:

Department will arrange internship for students in industries / organization after fifth semester or as per AICTE/ affiliating University guidelines & managing internships. The general procedure for arranging internship is given below:

Step 1: Request Letter/ Email should go to industry to allot various slots of 4-6 weeks as internship periods for the students. Students request letter /profile / interest areas may be submitted to industries for their willingness for providing the training.

Step 2: Industry will confirm the training slots and the number of seats allocated for internships via Confirmation Letter/ Email. In case the students arrange the training themselves the confirmation letter will be submitted by the students.

Step 3: Students on joining Training at the concerned Industry / Organization, submit the Joining Report/ Letters / Email.

Step 4: Students undergo industrial training at the concerned Industry / Organization. In-between Faculty Member(s) evaluate(s) the performance of students once/twice by visiting the Industry/Organization and Evaluation Report of the students is submitted in department.

Step 5: Students will submit training report after completion of internship.

Step 6: Training Certificate to be obtained from industry.

Step 7: List of students who have completed their internship successfully will be issued by Training and Placement Cell.

b) Guidelines to the students:

Any absenteeism by students during their internship should be informed immediately to the mentor/reporting manager and the internal guide. No special considerations will be accepted. Students cannot take leave for college work or fest activities. The leave permission for any college related activities will be solely approved by the HOD. The monthly attendance format should be duly submitted to the internal guide by the intern.

c) Internal reporting Guidelines:

Every intern should send weekly report to their internal guide without fail. It is mandatory for the intern to send weekly reports to their respective guide on regular basis. Interns should have at least fortnightly verbal communication with the internal guide without fail. In cases where in the company wants to secure their confidential information in the project / internship report, the internal guide should duly co-ordinate with the respective mentor/reporting manager on the method of reporting to assure that no information will be leaked outside and is purely for academic purposes.

d) Internship Diary / Internship Workbook:

Students must maintain Internship Diary/ Internship Workbook. The main purpose of maintaining diary/workbook is to cultivate the habit of documenting. The students should record in the daily training diary account of the observations, impressions, information gathered and

suggestions given, if any. The training diary/workbook should be signed after every day by the supervisor/ in charge of the section where the student has been working.

Internship Diary/workbook and Internship Report should be submitted by the students along

with attendance record and an evaluation sheet duly signed and stamped by the industry to the Institute immediately after the completion of the training. Internship Diary / workbook may be evaluated on the basis of the following criteria:

- Proper and timely documented entries.
- Adequacy & quality of information recorded
- Data recorded.
- Thought process and recording techniques used.
- Organization of the information.

e) Internship Work Evaluation:

Every student is required to prepare a maintain documentary proofs of the activities done by him / her as internship diary or as workbook. The evaluation of these activities will be done by Programmed Head/ Cell In-charge / Project Head / faculty mentor or Industry Supervisor based on- overall compilation of internship activities, sub-activities, the level of achievement expected, evidence needed to assign the points and the duration for certain activities.

Assessment and Evaluation is to be done in consultation with internship supervisor (Internal and External - a supervisor from place of internship).

f) Evaluation through Seminar presentation / Viva-voce at the institute:

The student will give a seminar based on his training report, before an expert committee constituted by the concerned department as per norms of the institute. The evaluation will be based on the following criteria:

- ✓ Depth of knowledge and skills Communication & Presentation Skills.
- ✓ Team Work
- ✓ Creativity
- ✓ Planning & Organizational skills
- ✓ Adaptability and Analytical Skills
- ✓ Attitude & behavior at work.
- ✓ Societal Understanding
- ✓ Ethics
- ✓ Regularity and punctuality
- ✓ Attendance record
- ✓ Log book
- ✓ Student’s Feedback from External Internship Supervisor

g) Internship Report:

The report shall be presented covering following recommended fields but limited to:

- ✓ Title/Cover Page
- ✓ Internship completion certificate.
- ✓ Internship Place Details- Company background-organization and activities/Scope and object of the study / personal observation.
- ✓ Index/Table of Contents
- ✓ Introduction
- ✓ Title/Problem statement/objectives
- ✓ Motivation/Scope and rationale of the study
- ✓ Methodological details
- ✓ Results / Analysis /inferences and conclusion
- ✓ Suggestions / Recommendations for improvement to industry, if any
- ✓ Attendance Record
- ✓ List of reference (Library books, magazines and other sources)

h) Feedback from internship supervisor (External and Internal):

Post internship, faculty coordinator should collect feedback about student with following recommended parameters:

- ✓ Technical knowledge
- ✓ Discipline
- ✓ Punctuality
- ✓ Commitment
- ✓ Willingness to do the work
- ✓ Communication skill
- ✓ Individual work
- ✓ Team work
- ✓ Leadership

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304415: Mini Project

Teaching Scheme:	Credit	Examination Scheme:
Practical: 04 Hrs. / week	02	Term Work: 25 Marks Oral: 50 Marks

Course Objectives:

- To understand the ―Product Development Process‟ including budgeting through Mini Project.
- To plan for various activities of the project and distribute the work amongst team members.
- To inculcate electronic hardware implementation skills by -
- Learning PCB artwork design using an appropriate EDA tool.
- Imbibing good soldering and effective trouble-shooting practices.
- Following correct grounding and shielding practices.
- To develop student ‘s abilities to transmit technical information clearly and test the same by delivery of Seminar based on the Mini Project.
- To understand the importance of document design by compiling Technical Report on the Mini Project work carried out.

Course Outcome:

On completion of the course, student will be able to

CO1: Understand, plan and execute a Mini Project with team.

CO2: Implement electronic hardware by learning PCB artwork design, soldering techniques, testing and troubleshooting etc.

CO3: Prepare a technical report based on the Mini project.

CO4: Deliver technical seminar based on the Mini Project work carried out.

A) Execution of Mini Project

- Project group shall consist of not more than 3 students per group.
- Mini Project Work should be carried out in the Design / Projects Laboratory.
- Project designs ideas can be necessarily adapted from recent issues of electronic design magazines Application notes from well-known device manufacturers may also be referred.
- Use of Hardware devices/components is mandatory.
- Layout versus schematic verification is mandatory.
- Bare board test report shall be generated.
- Assembly of components and enclosure design is mandatory.

B) Selection: Domains for projects may be from the following, but not limited to:

- Instrumentation and Control Systems
- Electronic Communication Systems
- Biomedical Electronics
- Power Electronics
- Audio , Video Systems
- Embedded Systems
- Mechatronic Systems
- Microcontroller based projects should preferably use Microchip PIC controllers / ATmega controller / AVR microcontrollers / Ardino / Rasberry Pi.

C) Monitoring: (for students and teachers both): Suggested Plan for various activities to be monitored by the teacher.

Week 1 & 2: Formation of groups, Finalization of Mini project & Distribution of work.
Week 3 & 4: PCB artwork design using an appropriate EDA tool, Simulation.
Week 5 to 8: PCB manufacturing through vendor/at lab, Hardware assembly, programming (if required) Testing, Enclosure Design, Fabrication etc
Week 9 & 10: Testing of final product, Preparation, Checking & Correcting of the Draft Copy of Report
Week 11 & 12: Demonstration and Group presentations.

Log book for all these activities shall be maintained and shall be produced at the time of examination.

D) Report writing: A project report with following contents shall be prepared:

- Title
- Specifications
- Block Diagram
- Circuit Diagram
- Selection of components, calculations
- Simulation Results
- PCB Art work
- Testing Procedures
- Enclosure Design
- Test Results & Conclusion
- References

Savitribai Phule Pune University
Third Year of Electronics Engineering
VLSI and Design Technology (2019 Course)
304191 (B): Mandatory Audit Course - 6

Teaching Scheme:	Credit	Examination Scheme:
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List of Courses to be opted (Any one) under Mandatory Audit Course 6

- Patent Law for Engineers and Scientists
- English language for competitive exams
- Energy Resources, Economics and Environment
- Principles of Human Resource Management
- Six Sigma
- Non-Conventional Energy Resources

GUIDELINES FOR CONDUCTION OF AUDIT COURSE

In addition to credits courses, it is mandatory that there should be audit course (non-credit course) from second year of Engineering. The student will be awarded grade as AP on successful completion of audit course. The student may opt for two of the audit courses (One in each semester). Such audit courses can help the student to get awareness of different issues which make impact on human lives and enhance their skill sets to improve their employability. List of audit courses offered in the semester is provided in the curriculum. Student can choose one of the audit course from list of courses mentioned. Evaluation of audit course will be done at institute level.

The student registered for audit course shall be awarded the grade AP and shall be included such grade in the Semester grade report for that course, provided student has the minimum attendance as prescribed by the Savitribai Phule Pune University and satisfactory in- semester performance and secured a passing grade in that audit course. No grade points are associated with this 'AP' grade and performance in these courses is not accounted in the calculation of the performance indices SGPA and CGPA. Evaluation of audit course will be doneat institute level itself.

Selecting an Audit Course:

Using NPTEL Platform:

NPTEL is an initiative by MHRD to enhance learning effectiveness in the field of technical education by developing curriculum based video courses and web based e-courses.The details of NPTEL courses are available on its official website www.nptel.ac.in

- Student can select any one of the courses mentioned above and has to register forthe corresponding online course available on the NPTEL platform as an Audit course.
- Once the course is completed the student can appear for the examination as per the guidelines on the NPTEL portal.
- After clearing the examination successfully; student will be awarded with certificate.

Assessment of an Audit Course:

- The assessment of the course will be done at the institute level. The institute hasto maintain the record of the various audit courses opted by the students. The audit course opted by the students could be interdisciplinary.
- During the course students will be submitting the online assignments. A copy of same students can submit as a part of term work for the corresponding Audit course.
- On the satisfactory submission of assignments, the institute can mark as “Present” and the student will be awarded the grade AP on the marksheet.