School of Engineering and Sciences

Electronics and Communication Engineering Department

M. Tech in VLSI

AY: 2022-2024

Department of Electronics and Communication Engineering

SRM University-Andhra Pradesh.

Semester-I						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	VLS511	CMOS Digital IC Design	3	0	0	3
2	VLS511L	CMOS Digital IC Design Lab	0	0	2	1
3	VLS512	Embedded Programming	3	0	0	3
4	VLS512L	Embedded Programming Lab	0	0	2	1
5	VLS513	VLSI Technology	3	0	0	3
6	AML501	Machine Learning Techniques	3	0	0	3
7	AML501L	Machine Learning Techniques Lab	0	0	3	2
8	OE	Open Elective-I	3	0	0	3
9	EGL501 (PC)	English for Research paper writing	1	0	0	1
10	VLS 548	Fundamentals in Business, Innovation and Project Management	1	0	0	1
		TOTAL	**17**	**0**	**7**	**21**

Semester-II						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	VLS521	VLSI Testing and Verification	3	0	0	3
2	VLS521 L	VLSI Testing and Verification Lab	0	0	2	1
3	VLS522	CMOS Analog and Mixed Signal IC Design	3	0	0	3
4	VLS522L	CMOS Analog and Mixed Signal IC Design Lab	0	0	2	1
5	TE-1	Technical Elective -1	3	0	0	3
6	TE-2	Technical Elective -2	3	0	0	3
7	TE-3	Technical Elective -3	3	0	0	3
8	VLS526	Mini Project-I	0	0	4	2
9	RM101	Research Methodology for IPR	2	0	0	2
		TOTAL	**17**	**0**	**8**	**21**

Semester-III						
S.No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1	OE	Open Elective II	3	0	0	3
2	VLS 539	MTech Dissertation/Project Part I	0	0	24	12
		TOTAL	**3**	**0**	**24**	**15**

Semester-IV						
S.No.	**Course Code**	Course Name	L	T	P	C
1	VLS549	MTech Dissertation Project Final	0	0	30	15
		TOTAL	**0**	**0**	**30**	**15**

List of Elective Courses are as follows:
1. VLS 551 - Low Power VLSI Design
2. VLS 552 - VLSI Accelerators for AI edge Computing Devices
3. VLS 553 - RFIC Design
4. VLS 554 - Signal Processing and Computer vision
5. VLS 555 - VLSI Architectures
6. VLS 556 - Hardware Algorithms for Computer Arithmetic
7. VLS 557 - VLSI Interconnects
8. VLS 558 - System on Chip
9. VLS 559 - High Speed VLSI Design
10. VLS 560 - Memory Design and Testing
11. VLS 561 - VLSI Subsystem Design
12. VLS 562 - Sensor Technology and MEMS
13. VLS 563 - Machine Learning
14. VLS 564 - Fault Tolerance in VLSI
15. VLS 565 - System Verilog
16. VLS 567 - CMOS Circuit Design for 5G
17. VLS 568 - Wireless Access Technologies
18. VLS 569 - CAD for VLSI
19. VLS 570 - Advanced topics in VLSI
20. VLS 571 - VLSI Broadband Communication Circuits
21. VLS 572 – VLSI Power Management Circuits
22. VLS 573 - Solar Cell Device Physics and Material Tech
23. VLS 574 - Electronic and Photonic Nano Devices
24. VLS 575 - Integrated Optoelectronic Devices
25. VLS514 -Semiconductor Device Modeling
26. VLS 580- More than Moore's electronics

SEMESTER -I

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 511	CMOS Digital IC Design	CC	3	0	0	3

UNIT-I

Introduction: Basic MOSFET Characteristics – Threshold Voltage, Body Bias concept, Current- Voltage Characteristics – Square-Law Model, MOSFET Modeling – Drain-Source Resistance, MOSFET Capacitances, Geometric Scaling Theory – Full-Voltage Scaling, Constant-Voltage Scaling, Challenges of MOSFET Scaling.

Layout of CMOS Logic Circuits: CMOS fabrication processing steps, Design Rules, Stick diagram, Layout of logic circuits, latch-up.

UNIT-II

Switching Properties of MOSFETs: Static and dynamic characteristics of Pass Transistors, Transmission Gate, TG based logic circuits.

CMOS Inverter: Basic Circuit and DC Operation – DC Characteristics, Noise Margins, Layout considerations, Inverter Switching Characteristics, Transient Effects on the VTC, RC Delay Modeling, Elmore Delay, Output Capacitance, Inverter Design – DC Design, Transient Design, Driving Large Capacitive Loads.

UNIT-III

Static CMOS Logic Elements: CMOS NAND Gate, CMOS NOR Gate, Complex Logic Functions, CMOS SRAM Cell.

Power Dissipation in CMOS Digital Circuits: Dynamic Power Dissipation – Switching Power Dissipation, Short Circuit Power Dissipation, Glitching Power Dissipation, Static Power Dissipation – Diode Leakage Current, Subthreshold Leakage Current.

UNIT-IV

Dynamic Logic Circuit Concepts and CMOS Dynamic Logic Families: Charge Leakage, charge Sharing, Dynamic RAM Cell, Clocked-CMOS, Pre-Charge/ Evaluate Logic, Domino Logic, Single-Phase Logic.

UNIT-V:

Issues in Chip Design: ESD Protection, On-Chip Interconnects – Line Parasitics, Modeling of the Interconnect Line, Clock Distribution, Input-Output circuits.

Text Books:

1. Kang, S. and Leblebici, Y., CMOS Digital Integrated Circuits – Analysis and Design, Tata McGraw Hill (2008) 3rd ed. 2. J P Uyemura, CMOS Circuit Design, Springer

Reference Books:

1. Weste, N.H.E. and Eshraghian, K., CMOS VLSI Design: A Circuits and Systems Perspective, eddision Wesley (1998) 2nd ed. 2. Baker, R.J., Lee, H. W. and Boyce, D. E., CMOS Circuit Design, Layout and Simulation, Wiley - IEEE Press (2004) 2nd ed. 3. Weste, N.H.E., Harris, D. and Banerjee, A., CMOS VLSI Design, Dorling Kindersley (2006) 3rd ed. 4. Rabaey, J.M., Chandrakasen, A.P. and Nikolic, B., Digital Integrated Circuits – A Design perspective, Pearson Education (2007) 2nd ed.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 511L	CMOS Digital IC Design Lab	CC	0	0	2	1

Laboratory work: Familiarization with schematic and layout entry using Mentor/ Cadence/ Tanner Tools, circuit simulation using SPICE; DC transfer Characteristics of Inverters, Transient response, Calculating propagation delays, rise and fall times, Circuit design of inverters, complex gates with given constraints; Circuit Simulation and Performance Estimation using SPICE; Layouts of CMOS circuits, Layout Optimization, Design Rule Check (DRC), Electrical Rule Check (ERC), Comparison of Layout Vs. Schematics, Circuit Extraction.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 512	Embedded Programming	CC	3	0	0	3

UNIT-I:

OVERVIEW: Embedded System Case Studies**,** Introduction to Embedded Systems**,** Getting to Know the Hardware**,** Learn How to Communicate**,** Getting to Know the Processor**,** Study the External Peripherals

UNIT-II:

ARM REFERENCE ARCHITECTURE: ARM Processor Architecture**,** ARM Software Development**,** ARM Instruction Sets**,** Getting Started with Embedded Software Development
(Tools, Packages, Platforms, etc.), Your First Embedded Program-Hello, ARM! The Blinking LED Program, The Role of the Infinite Loop, Compiling, Linking, and Locating, The Build Process

UNIT III:

SOFTWARE ARCHITECTURE: Four types of common architectures, Peripherals (drivers), Interrupts (ISR, IVT, pitfalls, etc.), Round-Robin, The Shared Data Problems, Function-Queue-Scheduling Architecture

UNIT IV:

EMBEDDED OPERATING SYSTEM: Real-Time Operating Systems, Interrupt Routines in an RTOS Environment, Tasks and Task States, Tasks and Data

UNIT-V:

EMBEDDED PROGRAMMING AND SECURITY: Embedded Systems Attacks:Uniquely Embedded Insecurities, Attackers and Assets: Common Firmware Vulnerabilities, Java: Concurrency, Pitfalls, and Wireless Applications

TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL

1. Barr, Michael, and Anthony Massa. Programming embedded systems: with C and GNU development tools. " O'Reilly Media, Inc.", 2006.
2. Simon, David E. An embedded software primer. Vol. 1. Addison-Wesley Professional, 1999.
3. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, MIT Press, ISBN 978-0-262-53381-2, 2017.
4. Barnett, R. H., O'Cull, L., Cox, S. A. (2007), Embedded C programming and the Atmel AVR. 2 editions. Clifton Park, N.Y.: Thomson Delmar Learning (532 p).
5. Wolf, Wayne (2008), Computers as components: principles of embedded computing system design. 2 editions. Amsterdam: Elsevier (507 p).

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 512 L	Embedded Programming Lab	CC	0	0	2	1

Laboratory work: ARM Assembly language program for doing arithmetic operation, ARM assembly language program for Memory operations, ARM Assembly - Interfacing memory mapped peripherals:

1. Binary Counter with LEDs
2. Real Time Clock
3. Analog to Digital converter
4. Digital to Analog Converter

C Program for peripheral interfacing

1. GPIO
2. Real Time Clock
3. Analog to Digital Converter
4. Digital to Analog Converter

C Program for Asynchronous and synchronous serial communication

1. UART
2. I2C/SPI

Embedded Ethernet applications, Controller Area Network (CAN) interface, RTOS Task Management, RTOS Inter Task Synchronization and Inter Task communication, Mini Capstone Project

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 513	VLSI Technology	CC	3	0	0	3

UNIT I:

Clean Room Environment and Wafer Preparation: Crystal Structure of a solid, Defects in materials Types of clean room, Contamination in clean room,

Electronic Grade Silicon Czochralski crystal growing, Silicon Shaping, Wafer cleaning processes and wet chemical etching techniques.

UNIT II:

Oxidation, Diffusion, and Implantation: Kinetics of Silicon dioxide growth both for thick, thin, and ultrathin films; Oxidation Techniques and Systems

Models of Diffusion in Solids, Defects due to oxidation, Solid State diffusion modelling and technology, Implantation Equipment, Principles, techniques and applications, removal of implant damage.

UNIT III:

Epitaxial Growth, Metallization's and MBE, Defects in Epitaxial Layer

Dielectric Deposition, PECVD and Rapid Thermal Annealing, E-beam evaporation, Sputtering, Thermal Evaporation, Dry Etching

UNIT – IV:

Lithography: Optical Lithography, E-beam lithography, X-ray, and Other Lithography techniques

UNIT-V:

Fabrication and Packaging: Fabrication of MOSFET, Process to Package a chip (Dicing, Attaching, wire bonding, Chip package header), Fabrications of other devices.

Textbooks:

1. S.M. Sze, "VLSI Technology", McGraw Hill, 2nd Edition. 2008
2. G. S. May, S. M. Sze, "Fundamentals of Semiconductor Fabrication" Wiley, 2003

Reference Books:

1. James D Plummer, Michael D. Deal, Peter Griffin, "Silicon VLSI Technology: fundamentals practice and Modeling", Prentice Hall India, 2009.
2. Wai Kai Chen, "VLSI Technology" CRC press, 2003.
3. S.K. Gandhi, VLSI Fabrication principles, Wiley.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
AML501	Machine Learning Techniques	C	3	0	0	3

UNIT I: INTRODUCTION

Introduction to Machine Learning: Introduction. Different types of learning, Hypothesis space and inductive bias, Evaluation. Training and test sets, cross validation, Concept of over fitting, under fitting, Bias and Variance.

Linear Regression: Introduction, Linear regression, Simple and Multiple Linear regression, Polynomial regression, evaluating regression fit.

UNIT II: DECISION TREE LEARNING:

Introduction, Decision tree representation, appropriate problems for decision tree learning, the basic decision tree algorithm, hypothesis space search in decision tree learning, inductive bias in decision tree learning, issues in decision tree learning, Python exercise on Decision Tree.

Instance based Learning: K nearest neighbor, the Curse of Dimensionality, Feature Selection: forward search, backward search, univariate, multivariate feature selection approach, Feature reduction (Principal Component Analysis), Python exercise on kNN and PCA.

Recommender System: Content based system; Collaborative filtering based.

UNIT III: PROBABILITY AND BAYES LEARNING:

Bayesian Learning, Naïve Bayes, Python exercise on Naïve Bayes, Logistic Regression. Support Vector Machine: Introduction, the Dual formulation, Maximum margin with noise, nonlinear SVM and Kernel function, solution to dual problem.

UNIT IV

Artificial Neural Networks: Introduction, Biological motivation, ANN representation, appropriate problem for ANN learning, Perceptron, multilayer networks and the back propagation algorithm,

UNIT V: ENSEMBLES:

Introduction, Bagging and boosting, Random Forest, Discussion on some research papers. Clustering: Introduction, K-mean clustering, agglomerative hierarchical clustering, Python exercise on k-mean clustering.

TEXTBOOKS

1. Machine Learning. Tom Mitchell. First Edition, McGraw- Hill, 1997.
2. Alpaydin, Ethem. Introduction to machine learning. MIT press, 2020.

REFERENCES

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Christopher Bishop, “Pattern Recognition and Machine Learning” Springer, 2007.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
AML501L	Machine Learning Techniques Lab	C	0	0	3	2

LIST OF PRACTICAL EXPERIMENTS

1. Basic exercises on Python Machine Learning P
2. packages such as NumPy, Pandas and matplotlib.
3. Given a dataset. Write a program to compute the Covariance, Correlation between a pair of attributes. Extend the program to compute the Covariance Matrix and Correlation Matrix.
4. Given a set of sample points in N dimensional feature space. Write a program to fit the points with a hyper plane using Linear Regression. Calculate sum of residual error.
5. Write a program that provides the option to compute different distance measures between two points in the N dimensional feature space. Consider some sample datasets for computing distances among sample points.
6. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
7. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Python ML library classes can be used for this problem.
8. Write a program to implement feature reduction using Principal Component Analysis
9. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
10. Given a dataset for classification task. Write a program to implement Support Vector Machine and estimate its test performance.
11. Write a program to implement perceptron for different learning task.
12. Write programs to implement ADALINE and MADALINE for given learning task.
13. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
14. Write a program to implement K means clustering algorithm. Select your own dataset to test the program. Demonstrate the nature of output with varying value of K.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
MAT500	Mathematics and Statistical Foundations for Data Science	OE	3	0	0	3

UNIT I: PROBABILITY

Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem and independence, Bayesian Inference,

UNIT II: STATISTICS

Basic Statistics, Estimate, Learning, Regression, Linear Regression, Multiple Linear Regression, Logistic Regression, Classification, Bayes Theorem for Classification, Sampling Methods, and Resampling Methods

UNIT III: RANDOM VARIABLES

Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, moment generating function, Chebyshev's inequality, Introduction to Stochastic Processes (SPs), Stationary Processes, Discrete-time Markov Chains (DTMCs), Continuous-time Markov Chains (CTMCs)

UNIT IV: LINEAR ALGEBRA

Finite dimensional vector spaces over a field; linear combination, linear dependence and independence; basis and dimension; inner-product spaces, linear transformations; matrix representation of linear transformations, Eigen values and eigenvectors, rank and nullity, inverse and linear transformation, Cayley-Hamilton Theorem

UNIT V: LINEAR ALGEBRA

Subset Selection, Shrinkage Methods, Dimension Reduction Methods, Support Vector Machine, principal Component analysis,

TEXTBOOKS

1. Sheldon Ross, A First Course in Probability, 7th Edition, Pearson, 2006
2. J. Medhi, Stochastic Processes, 3rd Edition, New Age International, 2009.

REFERENCES BOOKS

1. S.M. Ross, Stochastic Processes, 2nd Edition, Wiley, 1996.
2. Stephen H Friedberg, Arnold J Insel, Lawrence E. Spence, Linear Algebra. 4th Edition, Pearson, 2006.
3. Kenneth M Hoffman, Ray Kunz, Linear Algebra, 2nd Edition, Pearson
4. An Introduction to Statistical Learning - with Applications in R by Gareth James and Springer.

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
EGL 501(PC)	Mathematics and Statistical Foundations for Data Science	OE	1	0	0	1

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

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

UNIT III:
Review of the Literature, Methods, Results.

UNIT IV:
Key skills are needed when writing a Title, key skills are needed when writing an abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

UNIT V:
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions, Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

TEXT & REFERENCE BOOKS

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

SEMESTER-I

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 548	Fundamentals in Business, Innovation and Project Management	P	1	0	0	1

UNIT I: Introduction to Business

What is a Business Model-The Business Fundamentals and its types-The Business Owners/Managers-Your Goals & Planning- Your Business Finances-The Operational Systems & Processes- Your Team- The Brand- Sales & Marketing Plans-Customer Experience

UNIT II: What is Innovation

Are you innovative - What are the characteristics of Innovators - Why does Innovation matters -What kinds of innovation Exist-Social Innovation-Innovation Management Process-Stages of successful Innovation Idea Generation and Mobilization- Advocacy and Screening- Experimentation- Commercialization-Diffusion and Implementation.

UNIT III: Business Innovation

Models of Business Innovation-The 4 Vs of a Business Model- and new Business Models-The 9 most successful Business models of today

UNIT IV: Project Management

Four Phases of project Management-Planning, Buildup-Implementation-Closeout.

UNIT V: Design Thinking and IoT space

Design Thinking -The key to winning in the IoT space, 5 steps of Design Thinking for your IoT project, Case studies-IoT Business Models that are transforming Industries.

TEXTBOOKS/REFERENCE BOOKS

1) Introduction to Business Book by Amit Shah, Carl McDaniel, and Lawrence J Gitman
2) Understanding Business Paperback – International Edition, February 1, 2018 by William Nickels (Author), James McHugh (Author), Susan McHugh (Author)
3) How Innovation Works: And Why It Flourishes in Freedom by Matt Ridley
4) Ten Types of Innovation: The Discipline of Building Breakthroughs by Larry Keeley , Helen Walters , et al. | Apr 15, 2013
5) HBR Guide to Project Management by Harvard Business Review press,
6) Building the Internet of Things: Implement New Business Models, Disrupt Competitors, Transform Your Industry Hardcover – Illustrated, November 21, 2016, by Maciej Kranz

SEMESTER -II

SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS521	VLSI Testing and Verification	CC	3	0	0	3

UNIT-I: Introduction**:** Role of testing in VLSI design, Issues in test and verification of complex chips, VLSI test process and equipment, Test economics, Yield analysis and product quality. **Faults modelling and fault simulation:** Physical faults and their modelling, Stuck-at faults, bridging faults, Fault collapsing, Fault simulation, Deductive, Parallel and Concurrent fault simulation, Combinational and sequential SCOAP measures.

UNIT-II: ATPG for combinational circuits: D-Algorithm, Boolean Difference, PODEM, Random, Exhaustive and Weighted Test Pattern Generation, Aliasing and its effect on Fault coverage.

UNIT-III: ATPG for sequential circuits: ATPG for Single-Clock Synchronous Circuits, Time frame expansion method, Simulation-Based Sequential Circuit ATPG.

UNIT-IV: Memory testing and BIST: Permanent, Intermittent and pattern sensitive faults, March test notion, Memory testing using march tests, PLA testing, Ad-Hoc DFT methods, Scan design, Partial scan design, Random logic for BIST, Memory BIST.

UNIT-V: Verification: Design verification techniques based on simulation, Analytical and formal approaches, Functional verification, Timing verification, Formal verification, Basics of equivalence checking and model checking, Hardware emulation.

Hardware verification language: Introduction to System Verilog, Development of stimulus generator, Monitor and complete test bench using System Verilog.

Textbooks:1. M. Bushnell and Vishwani Agrawal, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits, Springer, ISBN 978-0792379911.

2. Chris Spear, System Verilog for Verification, Springer, ISBN 978-1-4614-0714-0

Reference Books:

1. M. Abramovic, M. Breuer, and A. Friedman, Digital System Testing and Testable Design, IEEE Press, 1994

2. Dhiraj K. Pradhan, “Fault Tolerant Computer System Design”, Prentice Hall.

3. L. T. Wang, C. W. Wu, and X. Wen, VLSI Test Principles and Architectures, Morgan Kaufmann, 2006, ISBN-13: 978-0-12-370597-6, ISBN-10: 0-12-370597-5.

4. System-on-a-Chip Verification-Methodology and Techniques, P. Rashinkar, Paterson and L. Singh, Kluwer Academic Publishers, 2001.

5. Janick Bergeron, “Writing test benches functional verification of HDL models” Kluwer Academic Publishers, New York, Boston, Dordrecht, London, Moscow, 2002.

SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS521 L	VLSI Testing and Verification Lab	CC	0	0	2	1

Laboratory Work: Familiarization with development of testbenches using Verilog/SystemVerilog on Mentor/Cadence/Xilinx-ISE tools, Logic simulation, Logic level diagnosis, ATPG, development of verification plan for the given design and writing testcases, computation of fault-coverage/code- coverage index.

SEMESTER-II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 522	CMOS Analog and Mixed Signal IC Design	CC	3	0	0	3

Objectives: To introduce analog MOS processes layout techniques, single stage amplifiers, working of operational amplifiers with frequency response, and noise impact.

UNIT I:

Building blocks for CMOS amplifiers: design of current mirrors, differential amplifiers.

CMOS operational transconductance amplifiers: design of single ended telescopic cascade, folded cascade and two-stage amplifiers.

UNIT II:

Frequency compensation schemes: Band gap references, OP-Amp Design

Switched capacitor circuits: Design of switched capacitor amplifiers and integrators, effect of Op-Amp finite gain, bandwidth and offset, circuit techniques for reducing effects of Op-Amp imperfections, switches and charge injection and clock feed-through effects.

UNIT III:

Data converter fundamentals: Analog versus Digital Discrete Time Signals, Converting Analog Signals to Data Signals, Sample and Hold Characteristics, DAC Specifications, ADC Specifications.

UNIT – IV:

Data Converters Architectures: DAC Architectures, Digital Input Code, Resistors String, R-2R Ladder Networks, Current Steering, Charge Scaling DACs, Cyclic DAC, Pipeline DAC, ADC Architectures, Flash, 2-Step Flash ADC, Pipeline ADC, Integrating ADC, Successive Approximation ADC.

UNIT-V:

Design of **PLL's** and **DLL's** and **frequency synthesizers**.

Textbooks:

1. R. Jacaob Baker, ―CMOS: Circuit Design, Layout and Simulation‖, 3rd Edition, Wiley-IEEE Press, 2010.
2. R. Jacaob Baker, ―CMOS- Mixed Signal Circuit Design‖, 2nd Edition, Wiley-IEEE Press, 2009.
3. B. Razavi, ―Design of Analog CMOS Integrated Circuits‖ 1st Edition, McGraw Hill, 2000.

Reference Books:

1. P. E. Allen and D. R. Holberg, ―CMOS Analog Circuit Design‖ 2nd Edition, Oxford University Press, 2002.
2. R. Gregorian, ―Introduction to CMOS opamps and comparators‖. Wiley, 1999. D. Johns and K.Martin, ―Analog integrated circuit design‖, Wiley, 1997.

SEMESTER II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
VLS 522 L	CMOS Analog and Mixed Signal IC Design Lab	CC	0	0	2	1

Laboratory work: Review of Mentor/Cadence Tools; Analysis of Various Analog Building Blocks such as, Current and Voltage References/Sources, Current Mirrors, Differential Amplifier, Design and Analysis of Op-Amp, Analog Layout Constraints, Layout Designs and Analysis.

SEMESTER II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
TE-1	Technical Elective-1	TE	3	0	0	3

SEMESTER II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
TE-2	Technical Elective -2	TE	3	0	0	3

SEMESTER II

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
TE-3	Technical Elective-3	TE	3	0	0	3

SEMESTER-II

VLS 526	Mini Project-I	L	T	P	C
		0	0	4	2
Co-requisite:	NIL				
Prerequisite:					
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	The purpose of this course is to practically implement project and present

At the end of the course, student will be able to							
	Understand contemporary/emerging technology for various processes and systems						
	Share Knowledge effectively in oral and written form and formulate documents						

SEMESTER-II

RM 101(PC)	Research Methodology & IPR	L	T	P	C
		2	0	0	2
Co-requisite:					
Prerequisite:					
Data Book / Codes/Standards					
Course Category	PC				
Course designed by	DEPARTMENT OF ECE				
Approval	-- Academic Council Meeting --, 20				

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

Session	Description of Topic	Contact hours
	UNIT-I	**5**
1.	Meaning of research problem, Sources of research problem.	1
2.	Criteria Characteristics of a good research problem, Errors in selecting a research problem.	1

3.	scope, and objectives of research problem.	1
4.	Approaches of investigation of solutions for research problem	1

5.	data collection, analysis, interpretation, Necessary instrumentations.	1
	UNIT-II	**5**
6.	Effective literature studies approach	2
7.	analysis Plagiarism	2
8.	Research ethics	1
	UNIT- III	**5**
9.	Effective technical writing, how to write report.	1
10.	Paper Developing a Research Proposal.	
11.	Format of research proposal.	
12.	a presentation and assessment by a review committee.	1
	UNIT-IV	**5**
13.	Nature of Intellectual Property: Patents, Designs, Trade and Copyright.	1
14.	Process of Patenting and Development: technological research	1
15.	innovation, patenting, development	1
16.	International Scenario: International cooperation on Intellectual Property.	1
17.	Procedure for grants of patents, Patenting under PCT.	1
	UNIT – V	**5**
18.	Patent Rights: Scope of Patent Rights.	2
19.	Licensing and transfer of technology	1
20.	Patent information and databases.	1

21.	Geographical Indications.	1
	UNIT – VI	**5**
22.	New Developments in IPR: Administration of Patent System.	2
23.	New developments in IPR; IPR of Biological Systems, Computer Software etc.	1
24.	Traditional knowledge Case Studies.	1
25.	IPR and IITs.	1

	Total contact hours	30

LEARNING RESOURCES	
	TEXTBOOKS/REFERENCE BOOKS/OTHER READING MATERIAL
1.	Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'"
2.	Wayne Goddard and Stuart Melville, "Research Methodology: an Introduction"
3.	Ranjit Kumar, 2nd Edition, "Research Methodology: A Step-by-Step Guide for beginners"
4.	Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
5.	May all, "Industrial Design", McGraw Hill, 1992.
6.	Niebel, "Product Design", McGraw Hill, 1974
7.	Asimov, "Introduction to Design", Prentice Hall, 1962
8.	Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
9.	T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

SEMESTER-III

SEMESTER III

Course Code	Course Name	Course Category	Credits			
			L	T	P	C
OE	OPEN ELECTIVE	OE	3	0	0	3

SEMESTER-III

VLS 539	M. Tech Dissertation Final/Major Project Phase-1	L	T	P	C
		0	0	24	12
Co-requisite:	NIL				
Prerequisite:					
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	
At the end of the course, student will be able to	
1	Understand contemporary/emerging technologies for various processes and systems
2	Share Knowledge effectively in oral and written form and formulate documents and communicate results to a peed reviewed journal
3	implement state of the art and industry standard projects

SEMESTER-IV

SEMESTER-IV

VLS 549	M. Tech Dissertation Final/Major Project Phase-2	L	T	P	C
		0	0	30	15
Co-requisite:	NIL				
Prerequisite:					
Data Book / Codes/Standards	NIL				
Course Category	P PROFESSIONAL CORE				
Course designed by	Department of Electronics and Communication Engineering				
Approval					

PURPOSE	
At the end of the course, student will be able to	
1	Understand contemporary/emerging technologies for various processes and systems
2	Share Knowledge effectively in oral and written form and formulate documents and communicate results to a peed reviewed journal
3	implement state of the art and industry standard projects