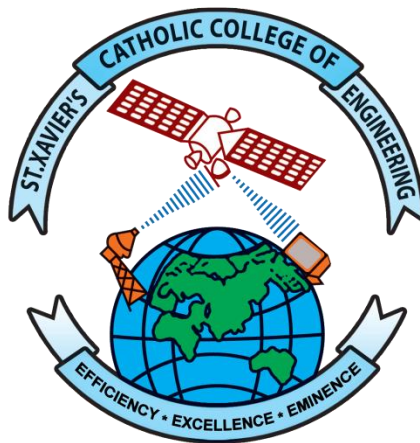# M.E. Degree

in

VLSI DESIGN

CURRICULUM & SYLLABUS (CBCS)

(For students admitted from the Academic Year 2025-2026)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

CHUNKANKADAI, NAGERCOIL – 629 003.

KANYAKUMARI DISTRICT, TAMIL NADU, INDIA

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING
Chunkankadai, Nagercoil – 629 003
AUTONOMOUS COLLEGE AFFILIATED TO ANNA UNIVERSITY
ACADEMIC REGULATIONS 2022
M.E. VLSI DESIGN CURRICULUM
CHOICE BASED CREDIT SYSTEM

Inconsonance to the vision of our College,

An engineering graduate we form would be a person with optimal human development, i.e. physical, mental, emotional, social and spiritual spheres of personality.

He/she would be also a person mature in relationships, especially knowing how to treat everyonewith respect, including persons of complementary gender with equality and gender sensitivity guidedby clear and pro-social values.

He would be patriotic and would hold the Indian Constitution and all the precepts it outlays close to his heart and would have a secular spirit committed to safeguard and cherish the multi-cultural, multi- religious and multi-linguistic ethos of Indian Society.

Academically, he/she would be a graduate with a strong engineering foundation with proficient technical knowledge and skills. He would have enough exposure and experience into the ethos of relevant industry and be industry ready to construct a successful career for himself and for the benefit of the society.

He would have been well trained in research methodology and would have established himself as a researcher having taken up many research projects, with sound ethical standards and social relevance. He would be a person with a passion for technical innovations committed to lifelong learning and research.

He would be well prepared and confident to develop ingenuous solutions to the problems people face as an individual and as a team and work for the emancipation of our society with leadership and courage.

ME (VLSI Design) is a PG course in Electronics and Communication Engineering that is made to acquire in-depth knowledge of Analog and Digital IC designs, System On Chip designs which can find it's application in the field of communication, signal processing and networking, computer design etc. including wider and global perspective. The course is for 2 years which is then divided into 4 semesters.

This course offers a comprehensive, in-depth study on analog and digital systems for making chips using latest technologies, low power design techniques for minimizing power consumption, VLSI testing methods for improving the yield.
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I. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I.	Apply technical knowledge and skills to have successful career in industry, government and academia as VLSI engineers.
II.	Pursue multidisciplinary scientific research in VLSI and related areas for the benefits of society.
III.	Make use of various state-of art systems and cutting-edge technologies to solve various complex engineering problems.
IV.	Inculcate leadership skills, team work, effective communication and lifelong learning to the success of their organization and nation.
V.	Practice ethics and exhibit commitment in profession to empower / enable rural communication infrastructure.

II. PROGRAMME OUTCOMES (POs)

PO#	Programme Outcomes
1	Independently carry out research/investigation and development work to solve practical problems.
2	Write and present substantial technical report/document.
3	Demonstrate a degree of mastery over the techniques in the area of analog and digital VLSI system design.
4	Analyze and design the subsystems in RF, signal processing, modern communication systems and networks.
5	Solve problems in analog and digital system design using advanced hardware and software tools.
6	Interact effectively with the technical experts in industry and society.

PEO's – PO's MAPPING:

PEOPROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES					
	1	2	3	4	5	6
I.	2	1	2	3	3	2
II.	2	1	2	3	3	2
III.	2	1	2	3	3	2
IV.	2	1	2	-	-	-
V.	1	1	2	-	-	2

PROGRAMME ARTICULATION MATRIX

Year	Semester	Course name	PO					
			1	2	3	4	5	6
I	I	Graph Theory and Optimization Techniques	2	-	1	1	-	-
		Analog IC Design	1	-	2	2	1	-
		Semiconductor Devices and Modeling	2	-	1	1	2	-
		Advanced Digital System Design	1	-	1	1	1	-
		Analog IC Design Laboratory	2	-	2	3	2	-
		Technical Seminar	3	3	2	-	-	3
		Research Methodology	-	2	3	-	-	2

M.E. VLSI DESIGN CURRICULUM

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	MA22110	Graph Theory and Optimization Techniques	FC	3	1	0	4	4
2	VL22101	Analog IC Design	PCC	3	0	0	3	3
3	VL22102	Semiconductor Devices and Modeling	PCC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
4	VL22103	Advanced Digital System Design	PCC	3	0	2	5	4
PRACTICAL COURSES								
5	VL22104	Analog IC Design Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
6	VL22105	Technical Seminar	EEC	0	0	2	2	1
7	RM22101	Research Methodology	RMC	2	0	0	2	2
MANDATORY COURSES								
8		Audit Course I	AC	2	0	0	2	0
		TOTAL		16	1	8	25	19

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	VL22201	Digital CMOS VLSI Design	PCC	3	0	0	3	3
2		Professional Elective I	PEC	3	0	0	3	3
3		Professional Elective II	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
4	VL22202	Design for Verification using UVM	PCC	3	0	2	5	4
5	VL22203	ASIC Design	PCC	3	0	2	5	4
6	VL22204	Low Power VLSI Design	PCC	3	0	2	5	4
PRACTICAL COURSES								
7	VL22205	FPGA Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	RM22201	Research Tool Laboratory	RMC	0	0	4	4	2
MANDATORY COURSES								
9		Audit Course II	AC	2	0	0	2	0
		TOTAL		20	0	14	34	25

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1		Professional Elective III	PEC	3	0	0	3	3
2		Open Elective	OEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
3		Professional Elective IV	PEC	3	0	2	5	4
EMPLOYABILITY ENHANCEMENT COURSES								
4	VL22301	Inplant / Industrial / Practical Training (4 weeks during summer vacation)	EEC	0	0	4	4	2
5	VL22302	Project Work I	EEC	0	0	6	6	3
		TOTAL		9	0	12	21	15

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
EMPLOYABILITY ENHANCEMENT COURSES								
1	VL22401	Project Work II	EEC	0	0	24	24	12
		TOTAL		0	0	24	24	12

TOTAL CREDITS: 71

PROFESSIONAL ELECTIVES

SEMESTER II, PROFESSIONAL ELECTIVES – I

S. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL22211	CMOS Fabrication Technology	PEC	3	0	0	3	3
2.	VL22212	Electromagnetic Interference and Compatibility	PEC	3	0	0	3	3
3.	VL22213	Advanced Wireless Sensor Networks	PEC	3	0	0	3	3
4.	VL22114	Hardware Software Co Design	PEC	3	0	0	3	3
5.	VL22215	Hardware Security	PEC	3	0	0	3	3
6.	VL22216	Pattern Recognition	PEC	3	0	0	3	3

SEMESTER II, PROFESSIONAL ELECTIVES – II

Sl. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL22221	Mixed Signal VLSI Design	PEC	3	0	0	3	3
2.	VL22222	VLSI for Wireless Communication	PEC	3	0	0	3	3
3.	VL22223	RF IC Design	PEC	3	0	0	3	3
4.	VL22224	Embedded Sysem Design	PEC	3	0	0	3	3
5.	VL22225	Power Management and Clock Distribution Circuits	PEC	3	0	0	3	3
6.	VL22226	Reconfigurable Architectures	PEC	3	0	0	3	3

SEMESTER III, PROFESSIONAL ELECTIVES – III

Sl. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL22311	VLSI Testing	PEC	3	0	0	3	3
2.	VL22312	Signal Integrity for High Speed Design	PEC	3	0	0	3	3
3.	VL22313	VLSI Signal Processing	PEC	3	0	0	3	3
4.	VL22314	CAD for VLSI Design	PEC	3	0	0	3	3
5.	VL22315	System On Chip	PEC	3	0	0	3	3
6.	VL22316	Nano Scale Devices	PEC	3	0	0	3	3

SEMESTER III, PROFESSIONAL ELECTIVES - IV

Sl. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	VL22321	Physical Design Automation	PEC	3	0	2	5	4
2.	VL22322	System Verilog	PEC	3	0	2	5	4
3.	VL22323	Digital Imaging and Video Processing	PEC	3	0	2	5	4
4.	MX22313	Deep Learning	PEC	3	0	2	5	4
5.	VL22324	PCB Design	PEC	3	0	2	5	4
6.	VL22325	Adaptive Signal Processing	PEC	3	0	2	5	4

AUDIT COURSES (AC)

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	AC22101	English for Research Paper Writing	2	0	0	0
2.	AC22102	Constitution of India	2	0	0	0
3.	AC22201	Disaster Management	2	0	0	0
4.	AC22202	நற்றமிழ் இலக்கியம	2	0	0	0

S.No	Subject Area	Credits per Semester				Total Credits
		I	II	III	IV	
1	FC	4	-	-	-	**4**
2	PCC	12	17	-	-	**29**
3	PEC	-	6	7	-	**13**
4	OEC	-	-	3	-	**3**
5	EEC	1	2	5	12	**20**
6	RMC	2	-	-	-	**2**
7	Non-Credit AC	0	0	-	-	**0**
	TOTAL	19	25	15	12	71

M.E. VLSI Design

SEMESTER – I

MA22110	GRAPH THEORY AND OPTIMIZATION TECHNIQUES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES:
- To introduce graph as mathematical model to solve connectivity related problems.
- To introduce fundamental graph algorithms
- To familiarize the students with the formulation and construction of a mathematical model for a linear programming problem in a real-life situation
- To understand, develop and solve mathematical model of Transportation and assignment problems
- To understand the applications of simulation modeling in engineering problems

UNIT I	GRAPHS	12

Graphs and graph models – Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism- Connectivity (Definitions and examples only)– Euler and Hamilton paths (Definitions and examples only).

UNIT II	GRAPH ALGORITHM	12

Graph Algorithms – Directed graphs – Some basic algorithms – Shortest path algorithms – Depth – First search on a graph – Theoretic algorithms – Performance of graph theoretic algorithm.

UNIT III	LINEAR PROGRAMMING	12

Formulation of liner programming problem - Graphical method of solution –Canonical and standard form of liner programming problem - Some important definitions - Simplex Method – Two phase method

UNIT IV	TRANSPORTATION AND ASSIGNMENT MODELS	12

Definition of the transportation model - Formulation - Basic feasible solution: North- West corner rule - least cost method- Vogel's approximation method **-** Definition of the assignment Model - Mathematical formulation of assignment models – Hungarian method for solution of the assignment problem

UNIT V	SIMULATION MODELLING	12

Monte Carlo Simulation – Types of Simulation – Elements of Discrete Event Simulation – Generation of Random Numbers.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Apply graph as mathematical model to solve connectivity related problems.
CO2:	Apply fundamental graph algorithms to solve certain optimization problems
CO3:	Formulate and construct mathematical models for linear programming problems
CO4:	Apply linear programming problem in transportation and assignment models to find initial and optimal solution
CO5:	Apply simulation modeling techniques to problems drawn from industry management and other engineering fields

REFERENCES:

1.	Taha H.A, "Operation Research: An Introduction", Ninth Edition, Pearson Education, New Delhi, 2010.
2.	Gupta P. K, and Hira D.S., "Operation Research", Revise Edition, S. Chand and Company Ltd., 2012.

3.	Sharma J.K., "Operation Research", Third Edition, Macmillan Publishers India Ltd.,2009.
4.	Douglas B. West, "Introduction to Graph Theory", Pearson Education, New Delhi,2015.
5.	Balakrishna R., Ranganathan. K., "A text book of Graph Theory", Springer Science and Business Media, New Delhi, 2012.
6.	Narasingh Deo, "Graph Theory with Applications to Engineering and Computer Science", Prentice Hall India,1997.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
CO1	2	-	1	1	-	-
CO2	2	-	1	1	-	-
CO3	2	-	1	1	-	-
CO4	2	-	1	1	-	-
CO5	2	-	1	1	-	-
CO	2	-	1	1	-	-

VL22101	ANALOG IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To learn the basics of single stage analog CMOS amplifiers
- To gain knowledge in noise characteristics of amplifiers
- To study the performance parameters of amplifiers and compensation techniques
- To design an analog amplifier with band gap reference

UNIT I	SINGLE STAGE AMPLIFIERS	9

Basic MOS physics and equivalent circuits and models - CS, CG and Source Follower- differential amplifier with active load- Cascode and Folded Cascode configurations with active load- design of Differential and Cascode Amplifiers- to meet specified SR, noise, gain, BW, ICMR and power dissipation, voltage swing, high gain amplifier structures.

UNIT II	HIGH FREQUENCY AND NOISE CHARACTERISTICS OF AMPLIFIERS	9

Current mirrors, cascode stages for current mirrors, current mirror loads for differential pairs. Miller effect, association of poles with nodes, frequency response of CS, CG and source follower, cascode and differential pair stages, Statistical characteristics of noise, noise in single stage amplifiers, noise in differential amplifiers.

UNIT III	FEEDBACK AND OPERATIONAL AMPLIFIERS	9

Properties and types of negative feedback circuits, effect of loading in feedback networks, operational amplifier performance parameters, Single stage Op Amps, two-stage Op Amps, input range limitations, gain boosting, slew rate, power supply rejection, noise in Op Amps.

UNIT IV	STABILITY AND FREQUENCY COMPENSATION	9

General considerations, Multiple systems, Phase Margin, Frequency Compensation, Compensation of two stage Op Amps, Slewing in two stage Op Amps, Other compensation techniques.

UNIT V	BAND GAP REFERENCE	9

Supply independent biasing, temperature-independent references, negative-TC voltage, positive TC voltage, Bandgap reference, PTAT generation, curvature correction, Design of BGR under low voltage conditions.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Explain the basics of single stage analog CMOS amplifiers.
CO2:	Summarize the noise characteristics and frequency response of single stage amplifiers.
CO3:	Explain the performance parameters of feedback and differential amplifiers.
CO4:	Comprehend the compensation techniques in Op Amps.
CO5:	Design band gap reference circuits.

REFERENCES:

1.	Behzad Razavi, Design of Analog CMOS Integrated Circuit, McGraw Hill Education, 2017, Second Edition.

2.	Paul J. Hurst, Paul R. Gray, Robert G Meyer and Stephen H. Lewis, Analysis and Design of Analog Integrated Circuits, Wiley, 2024, Sixth Edition.
3.	Paul G. A. Jespers, Boris Murmann, "Systematic Design of Analog CMOS Circuits", Cambridge University press, 2017.
4.	Johan Huijsing, Rudy J. Van Der Plassche, Willy M.C. Sansen , "Analog Circuit Design: Operational Amplifiers, Analog to Digital Convertors, Analog Computer Aided Design", Springer US , 2013. Third Edition.
5.	David Johns, Tony Chan Carusone and Kenneth Martin, Analog Integrated Circuit Design, Wiley, 2011, Second Edition.
6.	Phillip E.Allen, Douglas R.Holberg, "CMOS Analog Circuit Design", Second edition, Oxford University Press, 2011.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	-	2	2	1	-
CO2	1	-	2	2	1	-
CO3	1	-	2	2	1	-
CO4	1	-	2	2	1	-
CO5	1	-	2	2	1	-
CO	1	-	2	2	1	-

VL22102	**SEMICONDUCTOR DEVICES AND MODELING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop a strong foundation in semiconductor theory, devices, and their practical applications.
- To gain comprehensive knowledge of semiconductor device modeling and its relevance to the design of electronic systems.
- To understand various aspects of semiconductor device modeling essential for advanced electronic design and analysis.

UNIT I	**MOS CAPACITORS**	**9**

Surface Potential: Accumulation, Depletion, and Inversion, Electrostatic Potential and Charge Distribution in Silicon, Capacitances in an MOS Structure, Polysilicon-Gate Work Function and Depletion Effects, Charge in Silicon Dioxide and at the Silicon–Oxide Interface, High-Field Effects: Impact Ionization and Avalanche Breakdown, Band-to-Band Tunneling, Tunneling into and through Silicon Dioxide, Injection of Hot Carriers from Silicon into Silicon Dioxide.

UNIT II	**MOSFET DEVICES**	**9**

Long-Channel MOSFETs: Drain-Current Model, MOSFET I–V Characteristics, Subthreshold Characteristics, MOSFET Channel Mobility, MOSFET Capacitances and Inversion-Layer Capacitance Effect, Short-Channel MOSFETs, Short-Channel Effect, Velocity Saturation, Channel Length Modulation, MOSFET Breakdown.

UNIT III	**CMOS DEVICE DESIGN**	**9**

MOSFET Scaling: Constant-Field Scaling, Constant-Voltage Scaling, Nonscaling Effects, Threshold Voltage, Threshold-Voltage Requirement, Channel Profile Design, Nonuniform Doping, Quantum Effect on Threshold Voltage, MOSFET Channel Length: Various Definitions of Channel Length, Extraction of the Effective Channel Length, Extraction of Channel Length by C–V Measurements.

UNIT IV	**BIPOLAR DEVICES**	**9**

Modifying the Simple Diode Theory for Describing Bipolar Transistors, Ideal Current–Voltage Characteristics: Current density equation, Collector current, Base current, Characteristics of a Typical n–p–n Transistor: Effect of Emitter and Base Series Resistances, Effect of Base–Collector Voltage on Collector Current, Collector Current Falloff at High Currents, Bipolar Device Models for Circuit and Time-Dependent Analyses: Basic dc Model, Basic ac Model, Small-Signal Equivalent-Circuit Model, Emitter Diffusion Capacitance.

UNIT V	**MATHEMATICAL TECHNIQUES FOR DEVICE SIMULATIONS**	**9**

Poisson equation, continuity equation, drift-diffusion equation, Schrodinger equation, hydrodynamic equations.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Understand the electrostatics of MOS capacitors.
CO2:	Illustrate the operation and characteristics of long-channel and short-channel MOSFETs.
CO3:	Explain CMOS device design principles. Summarize the device level characteristics of BJT transistors.
CO4:	Describe the functioning and modeling of bipolar junction transistors.
CO5:	Interpret the key mathematical models and equations used in semiconductor device simulations.

REFERENCES:

1.	Yuan Taur and Tak H.Ning, "Fundamentals of Modern VLSI Devices", Cambridge University Press, Second Edition,2016.
2.	Behzad Razavi,"Fundamentals of Microelectronics", Wiley Student Edition, third edition Edition,2021.
3.	Ansgar Jungel, "Transport Equations for Semiconductors", Springer, 2009
4.	Selberherr, S., "Analysis and Simulation of Semiconductor Devices", Springer-Verlag., 1984
5.	S.M.Sze, Kwok.K. NG, "Physics of Semiconductor devices", Third edition,Springer, 2021
6.	A.B. Bhattacharyya "Compact MOSFET Models for VLSI Design", John Wiley & Sons Ltd, 2009.
7.	J P Collinge, C A Collinge, "Physics of Semiconductor devices" Springer, 2002.
8.	Trond Ytterdal, Yuhua Cheng and Tor A. Fjeldly Wayne Wolf, "Device Modeling for Analog and RF CMOS Circuit Design", John Wiley & Sons Ltd, 2004

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	-	1	1	-	-
CO2	2	-	1	1	-	-
CO3	2	-	2	1	-	-
CO4	2	-	1	1	-	-
CO5	2	-	2	1	2	-
CO	2	-	1	1	2	-

VL22103	**ADVANCED DIGITAL SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	0	2	4

COURSE OBJECTIVES:

- To design synchronous sequential circuits.
- To understand about hazards and design in asynchronous sequential circuits.
- To learn how to test digital circuits for faults.
- To study the structure and working of programmable devices.
- To design and build digital circuits using software tools.

UNIT I	**SEQUENTIAL CIRCUIT DESIGN**	**9**

Analysis of Clocked Synchronous Sequential Circuits: A sequential Parity Checker, State Tables and Graphs, Reduction of State Tables and State Assignment, Design of Synchronous Sequential Circuits: Design Procedure, Design-Code Converter, Design of Iterative Circuits- Comparator.

UNIT II	**ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN**	**9**

Analysis of Asynchronous Sequential Circuit, Flow Table Reduction-Races-State Assignment-Transition Table and Problems in Transition Table- Design of Asynchronous Sequential Circuit - Static, Dynamic and Essential hazards, Designing Vending Machine Controller.

UNIT III	**FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS**	**9**

Fault Table Method, Path Sensitization Method, Boolean Difference Method, Fault Tolerance Techniques, Fault in PLA, Test Generation, DFT Schemes, Built in Self-Test.

UNIT IV	SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES	9
	Programming Logic Device Families, Designing Synchronous Sequential Circuit using PLA/PAL, Designing ROM with PLA, Realization of Finite State Machine using PLD.	
UNIT V	SYSTEM DESIGN USING VERILOG	9
	Hardware Modeling with Verilog HDL – Logic System, Data Types and Operators for Modelling in Verilog HDL - Behavioral Descriptions in Verilog HDL – HDL Based Synthesis – Synthesis of Finite State Machines– Structural Modeling – Compilation and Simulation of Verilog Code – Test Bench - Realization of Combinational and Sequential Circuits using Verilog, Introduction to System Verilog.	

		45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

Experiments based on Verilog HDL/System Verilog

1.	Design of Registers.
2.	Design of Counters.
3.	Design of Sequential Machines.
4.	Design of Serial Adders, Multiplier and Divider.

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Analyze and design synchronous sequential circuits.
CO2:	Analyze and design asynchronous sequential circuits.
CO3:	Illustrate the various fault diagnosis and testability techniques in digital circuits.
CO4:	Infer the design of synchronous circuits using programmable devices.
CO5:	Apply Verilog HDL for modeling, simulation, and synthesis of digital systems.

	TOTAL:75 PERIODS

REFERENCES:

1.	Charles H.Roth., "Fundamentals of Logic Design" Seventh Edition, Cengage Learning, 2014.
2.	M.D.Ciletti , Modeling, Synthesis and Rapid Prototyping with the Verilog HDL, Prentice Hall, 1999
3.	Nripendra N Biswas "Logic Design Theory" Prentice Hall of India, 2001.
4.	Palnitkar , Verilog HDL – A Guide to Digital Design and Synthesis, Pearson, 2003.
5.	Paragk.Lala "Digital System Design Using PLD" B S Publications, 2003.
6.	S.Salivahanan, S. Arivazhagan," Digital circuits and Design, Oxford University Press, Fifth Edition, 2022.
7.	Stephen D Brown, "Fundamentals of digital logic", TMH publication, 2007.
8.	John M Yarbrough," Digital logic application and design" Thomas Learning, 2001.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	-	1	1	1	-
CO2	1	-	1	1	1	-
CO3	1	-	1	1	1	-
CO4	1	-	1	1	2	-
CO5	1	-	1	1	1	-
CO	1	-	1	1	1	-

VL22104	ANALOG IC DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To learn industry standard Analog IC design
- To learn practical design of Analog amplifiers, current mirror etc.
- To learn the art of analog layout in IC design

LIST OF EXPERIMENTS

1.	Simulation of MOSFET IV characteristics and Extraction of second order parameters.
2.	Design and Analysis of CMOS inverter.
3.	Design and Analysis of basic single stage amplifiers (common source, common gate and common

	drain).
4.	Design and Analysis of differential amplifier with active load and current source load.
5.	Design and Analysis of simple current mirror and cascode current mirror.
6.	Design and Analysis of two stage op-amp with frequency compensation.
7.	Realize layout of CMOS inverter and perform post layout simulation.
8.	Realize layout of CS amplifier with active load, with NMOS transistor as drive and PMOS transistor as load and perform post layout simulation.

Lab Requirements:
Mentor Graphics Tool/ Cadence/ Synopsys/Industry Equivalent Standard Software.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Use EDA tools for Circuit Design
CO2:	Design analog Circuit using CMOS given a design specification.
CO3:	Design and carry out time domain and frequency domain simulations of simple analog building blocks.
CO4:	Perform Pre-Layout Simulation and Post-Layout Simulation in analog circuits

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	-	2	2	2	-
CO2	2	-	2	2	2	-
CO3	2	-	2	3	2	-
CO4	2	-	2	3	2	-
CO5	2	-	2	2	2	-
CO	2	-	2	3	2	-

VL22105	**TECHNICAL SEMINAR**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES: In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

- Selecting a subject, narrowing the subject into a topic
- Stating an objective
- Collecting the relevant bibliography (atleast 15 journal papers)
- Preparing a working outline
- Studying the papers and understanding the authors contributions and critically analysing each paper
- Preparing a working outline
- Linking the papers and preparing a draft of the paper
- Preparing conclusions based on the reading of all the papers
- Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained. Activities to be carried out

TOTAL: 30 PERIODS

METHOD OF EVALUATION:

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or	3rd week	3% (the selected information must be area specific and of international and national standard)

	workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularlyin your area 7. Attach a call for papers (CFP) from your area.		
Collection of Journal papers in the topic in the context of the objective – collect20 & then filter	• You have to provide a complete list of references you will be using-Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, •Favour "first" or "foundational" papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered	4th week	6% (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? 5 th week 8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper) •What simplifying assumptions does the author claim to be making? • What did the author do?	5th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	• How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (this component willbe evaluated based on the linking and classification amongthe papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose andconclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11th week	10% (this component willbe evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	5% (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity andlinking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th week & 15th week	10% (based on presentation and Viva-voce)

COURSE OUTCOMES:	
Upon completion of the course, the students will be able to	
CO1	Identify latest developments in the field of VLSI Design
CO2	Develop technical writing abilities for seminars, conferences and journal publications
CO3	Make use of modern tools to present the technical details

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
CO1	3	-	3	-	-	3
CO2	-	3	1	-	-	3
CO3	-	-	1	-	-	3
CO	3	3	2	-	-	3

RM22101	RESEARCH METHODOLOGY	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To give an overview of the research methodology and IPR, and explain the techniques of data collection and analysis

UNIT I	RESEARCH DESIGN	6

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II	DATA COLLECTION AND SOURCES	6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III	DATA ANALYSIS AND REPORTING	6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV	INTELLECTUAL PROPERTY RIGHTS	6

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V	PATENTS	6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.

	TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Outline the methodology of research
CO2:	Explain the research design, data collection methods, IPR and patent
CO3:	Prepare a well-structured research paper, scientific presentations and patent applications
CO4:	Develop awareness on IPR, patent law and procedural mechanism in obtaining a patent
CO5:	Compare the methods of measurement scale, questionnaire, sampling and data analysis

REFERENCES:

1.	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 11e (2012).
2.	Kothari C R, Gaurav Garg, "Research Methodology- Methods and Techniques" New Age International Publishers, 2019.
3.	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4.	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tool & techniques", Wiley, 2007
5.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", 2013.

Mapping of Course Outcomes to Programme Outcomes

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
CO1	-	-	3	-	-	-
CO2	-	-	3	-	-	-
CO3	-	2	3	-	-	-
CO4	-	-	3	-	-	-
CO5	-	-	3	-	-	2
CO	-	2	3	-	-	2

AUDIT COURSES

AC22101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:
- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I	INTRODUCTION TO RESEARCH PAPER WRITING	6

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

UNIT II	PRESENTATION SKILLS	6

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

UNIT III	TITLE WRITING SKILLS	6

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, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV	RESULT WRITING SKILLS	6

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.

UNIT V	VERIFICATION SKILLS	6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission.

TOTAL: 30 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to

CO1:	Understand that how to improve your writing skills and level of readability
CO2:	Learn about what to write in each section
CO3:	Understand the skills needed when writing a Title
CO4:	Understand the skills needed when writing the Conclusion
CO5:	Ensure the good quality of paper at very first-time submission

REFERENCES:

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

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
CO1	-	2	-	1	-	-
CO2	-	2	-	1	-	-
CO3	-	2	-	1	-	-
CO4	-	2	-	1	-	-
CO5	-	2	-	1	-	-
CO	-	2	-	1	-	-

AC22102	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early

	years of Indian nationalism.	
	• To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.	
	• Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.	
UNIT I	**HISTORY OF MAKING OF THE INDIAN CONSTITUTION**	**6**
History, Drafting Committee, (Composition & Working)		
UNIT II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**6**
Preamble, Salient Features.		
UNIT III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**6**
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, Methods, Results, Discussion, Conclusions, The Final Check.		
UNIT IV	**ORGANS OF GOVERNANCE**	**6**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.		
UNIT V	**LOCAL ADMINISTRATION**	**6**
District's Admini of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.		
UNIT VI	**ELECTION COMMISSION**	**6**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		
	TOTAL: 30 PERIODS	

COURSE OUTCOMES:	
Upon completion of the course, the students will be able to	
CO1:	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO2:	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3:	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO4:	Discuss the passage of the Hindu Code Bill of 1956.
CO5:	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

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

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Programme Outcomes					
	1	**2**	**3**	**4**	**5**	**6**
CO1	-	2	1	-	-	-
CO2	-	2	1	-	-	-
CO3	-	2	1	-	-	-
CO4	-	2	1	-	-	-
CO5	-	2	1	-	-	-
CO	-	2	1	-	-	-

AC22201	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
COURSE OBJECTIVES:					
• Summarize basics of disaster					

•	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.		
•	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.		
•	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.		
•	Develop the strengths and weaknesses of disaster management approaches		

UNIT I	INTRODUCTION		6

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

UNIT II	REPERCUSSIONS OF DISASTERS AND HAZARDS		6

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

UNIT III	DISASTER PRONE AREAS IN INDIA		6

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

UNIT IV	DISASTER PREPAREDNESS AND MANAGEMENT		6

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

UNIT V	RISK ASSESSMENT		6

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

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will be able to

CO1:	Summarize basics of disaster
CO2:	Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3:	Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4:	Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5:	Develop the strengths and weaknesses of disaster management approaches.

REFERENCES:

1	Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'NewRoyal book Company, 2007.
3	Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi, 2001.
4	Goel S. L., Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.

Mapping of Course Outcomes with Program Outcomes

Course Outcomes	Programme Outcomes					
	1	2	3	4	5	6
CO1	1	-	-	-	1	2
CO2	1	-	-	-	1	2
CO3	1	-	-	-	1	2
CO4	1	-	-	-	1	2
CO5	1	-	-	-	1	2
CO	1	-	-	-	1	2

AC22202		நற்றமிழ் இலக்கியம்	L	T	P	C
			2	0	0	0
UNIT I		சங்க இலக்கியம்				6
1.	தமிழின் துவக்க நூல் தொல்காப்பியம் – எழுத்து, சொல், பொருள்					
2.	அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம்					
3.	குறிஞ்சிப் பாட்டின் மலர்க்காட்சி					
4.	புறநானூறு (95,195) - போரை நிறுத்திய ஒளவையார்					
UNIT II		அறநெறித் தமிழ்				6

1. அறநெறி வகுத்த திருவள்ளுவர்
    - அறம் வலியுறுத்தல், அன்புடைமை, ஒப்புரவறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
    – ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை
    (தூய்மையை வலியுறுத்தும் நூல்)

UNIT III		இரட்டைக் காப்பியங்கள்				6

1. கண்ணகியின் புரட்சி - சிலப்பதிகார வழக்குரை காதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
    - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை

UNIT IV		அருள்நெறித் தமிழ்				6

1. சிறுபாணாற்றுப்படை
    - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஒளவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618) - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான் ஆகியவை பற்றிய செய்திகள்

UNIT V		நவீன தமிழ் இலக்கியம்				6

1.உரைநடைத் தமிழ்,
    - தமிழின் முதல் புதினம்,
    - தமிழின் முதல் சிறுகதை,
    - கட்டுரை இலக்கியம்,
    - பயண இலக்கியம்,
    - நாடகம்,
2.நாட்டு விடுதலை போராட்டமும் தமிழ் இலக்கியமும்,
3. சமுதாய விடுதலையும் தமிழ் இலக்கியமும்,
4.பெண் விடுதலையும் விளிம்பு நிலையினரின் மேம்பாட்டில்
  தமிழ் இலக்கியமும்,
5.அறிவியல் தமிழ்,
6.இணையத்தில் தமிழ்,
7.சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்.

		TOTAL: 30 PERIODS

REFERENCES:

1	தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University)
2	தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)
3	தர்மபுர ஆதீன வெளியீடு
4	வாழ்வியல் களஞ்சியம்

5	தமிழ்கலைக் களஞ்சியம் - தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)	
6	அறிவியல் களஞ்சியம் - தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்	