Dr. MAHALINGAM
COLLEGE OF ENGINEERING AND TECHNOLOGY
Udumalai Road, Pollachi, Coimbatore District - 642003
Established in 1998 ♦ Approved by AICTE ♦ Affiliated to Anna University
(A DIVISION OF NIA EDUCATIONAL INSTITUTIONS)
NAAC A++ GRADE
Cycle 3 (2023-2030)
The Highest Grade

Curriculum and Syllabi

Semesters I to VI

Regulations 2023

(2023 Batch Only)

Programme: B.E. Electronics Engineering (VLSI Design and Technology)
Curriculum and Syllabi: Semester I to VI
Recommended by Board of Studies on: 16.12.2024
Approved by Academic Council on: 03.01.2025

Action	**Responsibility**	**Signature of Authorized Signatory**
Designed and Developed By	B.E. Electronics Engineering (VLSI Design and Technology)	
Compiled By	Office of Controller of Examination	
Approved By	Principal	

Dr. Mahalingam College of Engineering and Technology, Pollachi 642003.

(An autonomous institution approved by AICTE and affiliated to Anna University)

Department of B.E. Electronics Engineering (VLSI Design and Technology)

Vision

To strive for excellence in Electronics and Semiconductor Engineering education, research and technological services imparting quality training to students, to make them competent and motivated engineers.

Mission:

In order to foster growth and empowerment, we commit ourselves to

- Impart high quality technical education in Electronics and Semiconductor Engineering through effective teaching- learning process and updated curriculum.
- Equip the students with professionalism and technical expertise to provide appropriate solutions to societal and industrial needs.
- Provide stimulating environment with updated facilities to pursue research through creative thinking and team work.

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Programme Educational Objectives (PEOs)

B.E. Electronics Engineering (VLSI Design and Technology) graduates will:

PEO1.Technical Expertise: Acquire a professional career and personal development in industries / higher studies / research assignments / entrepreneurs.

PEO2.Life-long learning: Sustain to develop their knowledge and skills throughout their career.

PEO3. Ethical Knowledge: Exhibit professionalism, ethical attitude, communication skills, team work and adapt to Current trends.

Programme Outcomes (POs) - Regulations 2023

On successful completion of B.E. Electronics Engineering (VLSI Design and Technology) programme, graduating students/graduates will be able to:

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

PO2. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions for complex problems.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs)

On successful completion of B.E. Electronics Engineering (VLSI Design and Technology) programme, graduating students/graduates will be able to:

PSO1. Design and Implementation of VLSI Circuits: Design and implement VLSI circuits utilizing appropriate design methodologies and optimization techniques.

PSO2. IC Design: Design ICs with optimal performance, power consumption, and area utilization, considering factors such as noise, timing constraints, and signal integrity.

Dr. Mahalingam College of Engineering and Technology, Pollachi
2023 Regulation - Course Code Generation Procedure for UG Courses

Regulation

Mode of Assessment	
Character Type – Number	
T	Theory
I	Theory with Practical
L	Practical
	Practical with Theory
E	Elective
O	Open Elective
P	Project
S	Skill Development Course/Internship
C	Customized

Semester Number	
Character Type – Number	
1 to 8	Semester
0	Floating

Sequence Number
Character Type – Number
01, 02, 03, . . . , 99

1	2	3	4	5	6	7	8
2	3	A	U	X	X	0	1

Board/Department/Programme/Course Type			
Character Type – Alphabet			
AD	Artificial Intelligence & Data Science	**ME**	Mechanical
AM	CSE (Artificial Intelligence & Machine Learning)	**SC**	CSE (Cyber Security)
AU	Automobile	**PH**	Physics
CE	Civil	**CH**	Chemistry
CS	Computer Science	**EN**	English
EA	Advanced Communication Technology	**MA**	Mathematics
EC	Electronics and Communication	**ES**	Employability Skills
EE	Electrical and Electronics	**VA**	Value Added Course
EV	VLSI Design & Technology	**SA**	Studio Activities
IT	Information Technology		

Programme: B.E. Electronics Engineering
(VLSI Design and Technology)
2023 Regulations
(For 2023 Batch Only)
Curriculum for Semester I to VI

Course Category	Course Code	Course Title	Duration	Credits	Marks
VAC	23VAL101	Induction Program	3 Weeks	-	100

Semester I

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI101	Communication Skills I	2	0	2	3	100	All
Minor	23MAI102	Matrices and Calculus	3	0	2	4	100	AU,EA,EC, EE,EV&ME
Minor	23CHI101	Chemistry for Electrical Sciences	3	0	2	4	100	EC,EE&EV
Major	23ECT101	Electron Devices	3	0	0	3	100	EA,EC&EV
Multi-Disciplinary	23ADT001	C Programming	3	0	0	3	100	CE, EA, EC,& EV
Multi-Disciplinary	23ADL001	C Programming Laboratory	0	0	3	1.5	100	CE, EA, EC,& EV
VAC	23VAL102	Wellness for Students	0	0	2	1	100	All
VAC	23VAT101	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	100	All
AEC	23SAL101	Studio Activities	0	0	2	-	-	All
		Total	**15**	**0**	**13**	**20.5**	**800**	-

Semester II

Course Category	Course Code	Course Title	Hours/ Week			Credits	Marks	Common to Programmes
			L	T	P			
AEC	23ENI201/ 23FLT201/ 23FLT202	Communication Skills II	2	0	2	3	100	All
		Foreign Language-Japanese	3	0	0			
		Foreign Language-German	3	0	0			
Minor	23MAI202	Complex Variables and Transforms	3	0	2	4	100	AU, EC, EE, EV & ME
Minor	23PHI201	Physics for Electrical Sciences	3	0	2	4	100	EA, EC, EE & EV
Major	23ECT001	Circuit Theory	3	0	0	3	100	EA, EC & EV
Multi-Disciplinary	23ITT202	Problem Solving and Python Programming	3	0	0	3	100	EA, EC & EV
Multi-Disciplinary	23MEL001	Engineering Drawing	1	0	3	2.5	100	AD,AM,AU, CS,EA,EC, EE,EV,IT, ME & SC
Major	23ECL001	Electric Circuits and Electron Devices Laboratory	0	0	3	1.5	100	EA, EC&EV
SEC	23ESL201	Professional Skills 1: Problem solving skills and Logical Thinking 1	0	0	2	1	100	All
VAC	23VAT201	தமிழரும் தொழில் நுட்பமும்/ Tamils and Technology	1	0	0	1	100	All
Multi-Disciplinary	23CHT202	Environmental Sciences	1	0	0	-	100	All
AEC	23SAL201	Studio Activities	0	0	2	-	-	All
		Total	**17**	**0**	**16**	**23**	**1000**	**-**

Semester III

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAI301	Numerical Techniques and Linear Algebra	3	0	2	4	100	-
Major	23EVT301	Digital Electronics	3	0	0	3	100	-
Major	23EVT302	Analog Electronics	3	0	0	3	100	-
Multi Disciplinary	23EVI301	Data Structures and Algorithms using Python	2	0	2	3	100	-
Major	23EVL301	Digital IC Laboratory	0	0	3	1.5	100	-
Major	23EVL302	Analog Electronics Laboratory	0	0	3	1.5	100	-
SEC	23ESL301	Professional Skills 2: Problem solving skills & Logical Thinking 2	0	0	2	1	100	All
VAC	23VAT301	Universal Human Values 2: Understanding Harmony	2	1	0	3	100	All
AEC	23SAL301	Studio Activities	0	0	2	-	-	All
		Total	**13**	**1**	**14**	**20**	**800**	**-**

Semester IV

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Minor	23MAI401	Probability Theory and Statistics	3	0	2	4	100	-
Major	23EVT401	Linear Integrated Circuits	3	0	0	3	100	-
Major	23EVT402	Signals and systems	3	1	0	4	100	-
Major	23EVI401	Fundamentals of VLSI	3	0	2	4	100	-
Major	23EVT403	Microprocessors and Microcontrollers	3	0	0	3	100	-
Major	23EVL401	Microprocessors and Microcontrollers Laboratory	0	0	3	1.5	100	-
Major	23EVL402	Linear Integrated Circuits Laboratory	0	0	4	2	100	-
SEC	23ESL401	Professional Skills 3 : Professional Development and Etiquette	0	0	2	1	100	All
AEC	23SAL401	Studio Activities	0	0	2	-	-	All
		Total	**15**	**1**	**15**	**22.5**	**800**	**-**

Course Category	Course Code	Course Title	Duration	Credits	Marks	Common to Programmes
SEC	23XXXXXX	Internship - 1 / Community Internship / Skill Development	2 Weeks - 4 Weeks	1	100	-

Semester V

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVT501	FPGA Based System Design	3	0	0	3	100	-
Major	23EVT502	Control System	3	1	0	4	100	-
Major	23EVT503	Digital Signal Processing	3	0	0	3	100	-
Major	23EVE501	Professional Elective - I	3	0	0	3	100	-
Major	23EVE502	Professional Elective - II	3	0	0	3	100	-
Major	23EVL501	FPGA Based System Design Laboratory	0	0	3	1.5	100	-
Major	23EVL502	Digital Signal Processing Laboratory	0	0	3	1.5	100	-
SEC	23ESL501	Professional Skills 4: Communication Skills and Interview Essentials	0	0	2	1	100	All
Project	23XXXXX	Reverse Engineering Project	0	0	6	3	100	All
AEC	23SAL501	Studio Activities	0	0	2	-	-	All
		Total	**15**	**1**	**16**	**23**	**900**	**-**

Semester VI

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVT601	CMOS Analog IC Design	3	0	0	3	100	-
Major	23EVT602	ASIC Design	3	0	0	3	100	-
Minor	23EVT603	Low Power VLSI Design	3	0	0	3	100	-
Major	23EVE601	Professional Elective – III	3	0	0	3	100	-
Major	23EVE602	Professional Elective – IV	3	0	0	3	100	-
Minor	23EVO601	Open Elective - I	3	0	0	3	100	-
Major	23EVL601	CMOS Analog IC Design Laboratory	0	0	3	1.5	100	-
Major	23EVL602	ASIC Design Laboratory	0	0	3	1.5	100	
SEC	23ESL601	Professional Skills 5: Campus to Corporate	0	0	2	1	100	All
AEC	23SAL601	Studio Activities	0	0	2	-	-	All
		Total	**18**	**0**	**10**	**22**	**900**	**-**

Course Category	Course Code	Course Title	Duration	Credits	Marks	Common to Programmes
SEC	23XXXXXX	Internship - 2 / Research Internship / Skill Development	2 Weeks – 4 Weeks	1	100	-

Tentative Curriculum for Semester VII and VIII

Semester VII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23XXXXXX	VLSI Technology	3	0	0	3	100	-
Major	23XXXXXX	Mixed Signal IC Design	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – V	3	0	0	3	100	-
Major	23XXXXXX	Professional Elective – VI	3	0	0	3	100	-
Minor	23XXXXXX	Open Elective – II	3	0	0	3	100	-
Major	23XXXXXX	PCB design Laboratory	0	0	4	2	100	
Major	23XXXXXX	Mixed Signal IC Design Laboratory	0	0	4	2	100	-
Project	23XXXXXX	Project Phase – I	0	0	8	4	100	-
		Total	**15**	**0**	**16**	**23**	**800**	**-**

Semester VIII

Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Project	23XXXXXX	Project Phase - II	0	0	12	6	200	-
SEC	23XXXXXX	Internship - 3 / Skill Development	8 Weeks			4	100	-
		Total	**6**	**0**	**16**	**10**	**300**	**-**

Total Credits: 166

Vertical wise Electives

Vertical I - Analog VLSI Design								
Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVE001	Active Filters Design	3	0	0	3	100	-
Major	23EVE002	Design of CMOS Phase Lock Loop	3	0	0	3	100	-
Major	23EVE003	High Speed Interconnects for VLSI design	3	0	0	3	100	-
Major	23EVE004	Art of Analog Layout design	3	0	0	3	100	-

Vertical II - Digital VLSI Design								
Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVE005	Digital IC Design	3	0	0	3	100	-
Major	23EVE006	VLSI Digital Signal Processing	3	0	0	3	100	-
Major	23EVE007	Scripting Language for Electronic Design Automation	3	0	0	3	100	-
Major	23EVE008	Memory Devices and Circuits	3	0	0	3	100	-
Major	23EVE009	Verification Methodologies	3	0	0	3	100	-

Vertical III - VLSI Applications								
Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVE010	VLSI Architectures for Image and Video Processing	3	0	0	3	100	-
Major	23EVE011	VLSI design of Neural Networks	3	0	0	3	100	-
Major	23EVE012	VLSI for wireless Communications	3	0	0	3	100	-
Major	23EVE013	Integrated Circuits for Optical Communication	3	0	0	3	100	-

Vertical IV - Fabrication and Advanced design Techniques								
Course Category	Course Code	Course Title	Hours/Week			Credits	Marks	Common to Programmes
			L	T	P			
Major	23EVE014	Microchip fabrication	3	0	0	3	100	-
Major	23EVE015	Power management and clock distribution	3	0	0	3	100	-
Major	23EVE016	Reliability in VLSI circuits	3	0	0	3	100	-
Major	23EVE017	Synthesis and optimization of VLSI circuits	3	0	0	3	100	-
Major	23EVE018	IP core design and protection	3	0	0	3	100	-
Major	23EVE019	Electronics Packaging	3	0	0	3	100	-
Major	23EVE020	Thin Film Characterization	3	0	0	3	100	-

SEMESTER I

Course Code:23VAL101	Course Title: Induction Program (Common to all B.E / B.Tech Programmes)	
Course Category: VAC	Course Level: Introductory	
Duration: 3 weeks	Mandatory Non-Credit Course	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Explain various sources available to meet the needs of self, such as personal items and learning resources
2. Explain various career opportunities, opportunity for growth of self and avenues available in the campus
3. Explain the opportunity available for professional development
4. Build universal human values and bonding amongst all the inmates of the campus and the society.

List of Activities:

1. History of Institution and Management: Overview on NIA Educational Institutions –Growth of MCET – Examination Process –OBE Practices –Code of Conduct – Centre of Excellence.
2. Lectures, interaction sessions and Motivational Talks by Eminent people, Alumni, Employer and Industry Experts
3. Familiarisation of Department / Branch: HoD's & Senior Interaction- Department Association
4. Universal Human Value Modules : Aspirations and concerns, Self Management, Relations Social and Natural Environment.
5. Orientation on Professional Skills Courses
6. Proficiency Modules : Mathematics, English, Physics and Chemistry
7. Introduction to various Chapters, Cells, Clubs and its events
8. Creative Arts : Painting, Music and Dance
9. Physical Activity :Games, Sports and Yoga
10. Group Visits: Visit to local area and Campus Tour

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1 : Explain various sources available to meet the needs of self, such as personal items and learning resources through visit to local areas and campus	Understand
CO2: Explain various career opportunities and avenues available in the campus through orientation sessions	Understand
CO3: Explain the opportunity available for professional development through professional skills, curricular, co-curricular and extracurricular activities	Understand
CO4: Build universal human values and bonding amongst all the inmates of the campus and society for having a better life	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1	PO1	PO1	PSO	PSO
CO1	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO2	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO3	1	-	-	-	-	-	-	2	1	2	-	-	-	-
CO4	2	-	-	-	-	-	-	2	1	2	-	-	-	-

High : 3, Medium :2, Low: 1

Text Book(s):

T1. Reading material, Workbook prepared by PS team of the college

Reference Book(s):

R1. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster Uk, 2004.

R2. Vethathiri Maharishi Institute For Spiritual and Intuitional Education, aliyar, “value educat harmonious life (Manavalakalai Yoga)”, Vethathri Publications, Erode, 2010.

R3. Dr.R.Nagarathna, Dr.H.R. Nagendra, “ Integrated approach of yoga therapy for positive Swami Vivekananada Yoga Prakashana Bangalore,2008 Ed.

Web References:

1. https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV
2. https://www.youtube.com/watch?v=P4vjfEVk&list=PLWDeKF97v9SO0frdgmpaghDMjkom1
3. https://fdp-si.aicte-india.org/download/AboutSIP/About%20SIP.pdf

Course Code: 23ENI101	Course Title: Communication Skills I (Common to all B.E/B.Tech Programmes)		
Course Category: AEC		Course Level: Introductory	
L:T:P(Hours/Week) 2:0:2	Credits: 3	Total Contact Hours:60	Max Marks:100

Course Objectives

The course is intended to impart formal and informal language effectively and accurately in various real-life contexts on par with B1 level of CEFR Scale.

Module I **20 Hours**

Grammar: Synonyms & Antonyms -Tense forms - Modals - Passives – Reported Speech – Comparatives and Descriptive adjectives.

Listening: Listening for gist and specific information - Listening to past events, experiences and job preferences - Listening to descriptions of monuments - Listening for excuses - Listening to description: transportation systems and public places.

Speaking: Introducing oneself - Exchanging personal information – Effective Conversations: Role Play Situations (Describing personality traits - Describing landmarks, monuments and festivals - Making polite requests and excuses - Discussing facts - Asking for and giving information – Expressing wishes - Talking about lifestyle changes - Talking about transportation and its problems - Describing positive and negative features of things and places - Making comparisons)

Reading: Skimming and Scanning - Reading Comprehension - Reading and comprehending online posts and emails – Case Studies

Writing: Letter writing (Permission letters - Online cover letter for job applications) - Instructions - Recommendations - Write a blog (General) - Report Writing (Industrial Visit Report and Event Reports) - formal and informal emails.

Module II **20 Hours**

Grammar: Sequence adverbs - Phrasal verbs - Relative clauses – Imperatives - Infinitives - Conditionals.

Listening: Listening to review of food items - Listening to results of surveys- Listening to motivational talks & podcasts

Speaking: Expressing likes and dislikes - Describing a favorite snack - Giving advices and suggestions - Speculating about past and future Events – Group Discussion

Reading: Reading different expository texts - Reading to factual texts - Print and online media- Reading Comprehension

Writing: Process Descriptions – Email Writing (Requesting for information) - Reviewing Movie – Social media feeds/posts (Any Social Media)

List of Experiments: **20 Hours**

1. Mini Presentation and Picture Prompt Discussion
2. Debate Tournament
3. Listening, Mind Mapping & Summarization
4. Listening to Stories and Providing the Innovative Climax
5. Reading Comprehension
6. Writing - Interpretation of Visuals

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1 : Utilize the basic English grammar and vocabulary to acquire professional communication skills.	Apply
CO 2 : Develop listening and speaking skills through classroom activities based on listening comprehension, recapitulation, interpretation and debate on the same	Apply
CO 3 : Read and write social media posts and comments	Apply
CO 4 : Perform as a member of a team and engage in individual presentation	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-

High-3; Medium-2;Low-1

Textbooks:

T1. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student’s book 2”, 5thEdition, Cambridge University Press, South Asia Edition, 2022.

T2. Jack C. Richards, Jonathan Hull, and Susan Proctor, “Interchange - Student’s Book 1”, 5thEdition, Cambridge University Press, South Asia Edition, 2022.

Reference Book(s):

R1. David Bohlke, Jack C. Richards, “Four Corners”, 2nd Edition, Cambridge University Press,2018.

R2. Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, Graham Burton,Empower B1 – Student’s Book, Cambridge University Press, 2020.

R3. Raymond Murphy, “Intermediate English Grammar” 30th Edition, Cambridge University Press,2022.

Web References:

1. https://speakandimprove.com/
2. https://writeandimprove.com/
3. https://www.cambridgeenglish.org/exams-and-tests/linguaskill/

Course Code: 23MAI102		Course Title: Matrices and Calculus (Common to AU, EA, EC, EE, EV & ME)	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week)3:0 :2	Credits: 4	Total Contact Hours:75	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on the use of matrix algebra techniques for practical applications, familiarize with differential calculus and acquire knowledge of mathematical tools to evaluate multiple integrals.

Module I **23 Hours**

Matrices

Definitions and examples of symmetric, skew symmetric and orthogonal matrices - Eigenvalues and Eigenvectors – Properties of Eigenvalues and Eigenvectors-Diagonalization of matrices through orthogonal transformation - Cayley-Hamilton Theorem (without proof) – verification problems and properties - Transformation of quadratic forms to canonical forms through orthogonal transformation.

Differential and Integral Calculus

Curvature – Radius of curvature –Centre of curvature- Circle of curvature - Evolutes and Involutes - Evaluation of definite and improper integrals - Beta and Gamma functions – Properties and applications.

Multivariable Differentiation I

Limit – continuity - Mean value theorems and partial derivatives - Taylor's series and Maclaurin's series – Jacobian of functions of several variables.

Module II **22 Hours**

Multivariable Differentiation II

Maxima, Minima and saddle points of functions of several variables - Method of Lagrange's multipliers.

Multiple Integral

Multiple Integration: Double integrals - Change of order of integration in double integrals - Change of variables (Cartesian to polar, Cartesian to spherical and Cartesian to cylindrical) - Triple integrals - Applications: Finding areas and volumes.

Ordinary Differential Equations Of Second and Higher Orders

Second and higher order linear differential equations with constant coefficients – Second order linear differential equations with variable coefficients (Cauchy - Euler equation, Legendre's equation) – Method of variation of parameters – Solution of first order simultaneous linear ordinary differential equations

List of Experiments: **30 Hours**

1. Introduction to MATLAB.
2. Rank of matrix and solution of system of linear algebraic equations.
3. Finding Eigen values and Eigen vectors of a matrix.
4. Solving ordinary differential equation.
5. Gram Schmidt Procedure.
6. Finding Maxima, Minima of a function.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Determine the canonical form of a quadratic form using orthogonal transformation.	Apply
CO2: Identify the evolute of a curve and solve the improper integrals using beta gamma functions.	Apply
CO3: Examine the extreme value of multivariate functions.	Apply
CO4: Evaluate the area and volume using multiple integrals and solve the higher order differential equations.	Apply
CO5: Demonstrate the understanding of calculus concepts through modern tools.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Erwinkreyzig, Advanced Engineering Mathematics, 9th edition, John Wiley& Sons, 2006.
T2. Veerarajan T., Engineering Mathematics for first year, 3rd edition, Tata McGraw-Hill,

Reference Book(s):

R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2002.

R2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

R3. P. Sivaramakrishna Das , C. Vijayakumari , Engineering Mathematics, Pearson India, 2017.

Web References:

1. https://nptel.ac.in/courses/111107112
2. https://nptel.ac.in/courses/111104031

Course Code: 23CHI101	Course Title: Chemistry for Electrical Sciences (Common to EC, EE & EV)		
Type of Course: Minor	Course Level: Introductory		
L:T:P (Hours/Week) 3: 0:2	Credits:4	Total Contact Hours:75	Max Marks:100

Course Objectives

The course is intended to impart the knowledge of chemistry involved in Electrochemistry, Corrosion and its control, Spectroscopic technique, Fuels and Nanomaterials.

Module: I **23 Hours**

Electrochemistry and Batteries:

Electrochemistry - Basic terminologies - Potentiometric titration – Nernst equation – Batteries – Types and Characteristics, Construction, working and applications - Lead –Acid battery, Lithium-ion battery – Fuel cells - Construction, working and applications – Hydrogen Oxygen fuel cell.

Corrosion and its Control:

Corrosion – Dry and Wet corrosion – Mechanism of electrochemical corrosion – Galvanic corrosion and Concentration cell corrosion, Factors influencing corrosion. Corrosion Control methods – Cathodic protection methods, Metallic coating – Galvanizing, Tinning – Chrome plating and Electroless plating of Nickel

Spectroscopic Techniques:

Spectroscopy- Electromagnetic spectrum, Absorption and Emission spectroscopy – Relationship between absorbance and concentration – Derivation of Beer-Lambert's law (problems).

Module: II **22 Hours**

Spectroscopic Techniques:

UV - Visible Spectroscopy, Atomic Absorption Spectroscopy, Flame photometry - Principle, Instrumentation, and applications.

Biofuels and Lubricants:

Biomass - Biogas - Constituents, manufacture and uses. General outline of fermentationprocess - manufacture of ethyl alcohol by fermentation process. Combustion - Calorific values -Gross and Net calorific value - Problems based on calorific value. Lubricants - Classification of lubricants - Properties of liquid lubricants and their significance - Greases - Common grease types and properties. Components of grease – Base oil, additives and thickener.

Synthesis and Applications of Nano Materials:

Introduction - Difference between bulk and Nano materials - size dependent properties. Nano scale materials - Particles, clusters, rods, and tubes. Synthesis of Nanomaterials: Sol-Gel process, Electro deposition, Hydrothermal methods. Applications of Nano materials in Electronics, Energy science and Medicines. Risk and future perspectives of nano materials.

LIST OF EXPERIMENTS: (Any 6 experiments) **30 Hours**

1. Estimation of Fe^{2+} by potentiometric titration.
2. Determination of corrosion rate by weight loss method.
3. Estimation of iron in water by spectrophotometry
4. Determination of Cloud and Pour Point.
5. Green Synthesis of Silver Nanoparticles by Neem leaf.
6. Conductometric titration of strong acid against strong base.
7. Determination of strength of acid by pH metry.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Understand and explain the chemistry involved in Electrochemistry, Corrosion, Spectroscopic techniques, Fuels and Nanomaterials.	Understand
CO2: Apply the acquired knowledge of chemistry to solve the Engineering problems.	Apply
CO3: Analyze the Engineering problems through the concept of Electro chemistry, Spectroscopic techniques, Fuels, and Nanomaterials.	Apply
CO4: Apply the knowledge of chemistry to investigate Engineering materials by volumetric and instrumental methods and analyze, interpret the data to assess and address the issues of Environmental Pollution	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	-	-

Text book(s):

T1. Jain and Jain, Engineering Chemistry, 17th Edition, Dhanpat Rai Publishing Company, New Delhi, 2018.

T2. Wiley Engineering Chemistry, 2nd Edition, Wiley India Pvt Ltd, New Delhi, 2011.

Reference Book(s):

R1. Dara S. S and Umare S. S., A textbook of Engineering Chemistry, 12th Edition, S. Chand & Co Ltd, New Delhi , 2014.
R2. V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar, Polymer Science,4th Edition New Age International(P) Ltd, Chennai ,2021.
R3. Jeffery G. H., Bassett. J., Mendham J and Denny R. C., Vogel's Textbook of Quantitative Chemical Analysis, 5th Edition Oxford, ELBS, London, 2012.

Web References:

1. http://nptel.ac.in/courses/122101001/downloads/lec.23.pdf
2. https://nptel.ac.in/courses/104106075/Week1/MODULE%201.pdf
3. https://nptel.ac.in/courses/103102015/

Course Code: 23ECT101		Course Title: Electron Devices (Common to EA ,EC & EV)	
Course Category: Major		Course Level: Introductory	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to impart knowledge of basic electronic devices such as diodes, Bipolar junction Transistors and Field effect transistors.

Module I **23 Hours**

Semiconductor Diode: PN junction - forward and reverse bias conditions. V-I Characteristics and its Temperature dependence – Diode specifications - Diode Resistance – Diode junction Capacitance – Transition and Diffusion capacitances - Rectifiers - Clipper - Clamper

Special Diodes: Zener diode - Characteristics of Zener diode - Avalanche and Zener breakdown - Application of Zener diode :Voltage regulator - Varactor diode, Tunnel diode, Light emitting diodes – Photo diodes

Bipolar Junction Transistors: Bipolar Junction Transistor and its types: NPN and PNP Transistor - Transistor operation - Configurations of BJT : Input and output characteristics of CE, CB and CC configurations - Transistor as a Switch and Amplifier.

Module II **22 Hours**

Field Effect Transistors: JFET and its types, construction and operation of n- channel and p-channel JFETs – characteristics curves – FET applications – Comparison of BJT and JFET

MOSFETS and Power Devices: MOSFETs: Depletion MOSFETs and Enhancement MOSFETs – construction and operation - Drain and Transfer characteristics - Differences between JFETs and MOSFETs – Precaution in handling MOSFETs - MOSFET as a switch.

Construction, operation and characteristics of SCR, DIAC, TRIAC, Power transistor and IGBT

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand and explain the construction and characteristics of PN junction diode, special diodes, BJTs, FETs and Power devices.	Understand
CO 2: Identify a suitable electronic device and develop appropriate circuit for the given application.	Analyze
CO 3: Engage in independent study as a member of a team and make an effective oral presentation on the applications of various Electron devices.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	2	2	-	1	1	-

High-3; Medium-2; Low-1

Text Book:

T1. Millman J. , Halkias C. C. "Electronic Devices and Circuits ", Tata McGraw Hill, New Delhi, 2011.

Reference Book(s):

R1. Salivahanan.S, Suresh kumar.N and Vallavaraj.A, “Electronic Devices and Circuits”, Second Edition, TMH, New Delhi, 2008.

R2. Robert Boylestad and Louis Nashelsky, “Electron Devices and Circuit Theory”, Pearson Prentice Hall, Tenth Edition, 2008.

R3. Streetman Ben G. and Banerjee Sanjay, “Solid State Electronic devices”, PHI, Sixth Edition, 2006

R4. David A. Bell, “Electronic Devices and Circuits”, Oxford University Press, Fifth Edition, 2008

Web References:

1. http://nptel.ac.in/video.php?subjectId=117103063
2. http://nptel.ac.in/video.php?subjectId=117106091
3. www.youtube.com/watch?v=Wf19II0ts84

Course Code: 23ADT001		Course Title: C Programming (Common to CE, EA, EC, EE & EV)	
Course Category: Multi-disciplinary		Course Level: Introductory	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course helps to understand the structured and procedural programming skills. The major objective is to provide students with understanding of code organization and functional hierarchical decomposition using complex data types.

Module I **22 Hours**

Basics Of Computer Organization: Generation and Classification of Computers – Basic Organization of a Computer – Software development life cycle – Problem Solving Techniques, Algorithm, Pseudo code and Flow Chart.

Introduction To C Programming: Introduction – Structure of a C program – Keywords – Identifiers – Constants – Variables – Data Types – Operators and Expressions – Formatted & Unformatted I/O functions – Decision statements – Loop control statements.

Arrays: Characteristics – Declaration- One-dimensional array, Two-dimensional arrays

Module II **23 Hours**

Functions: Declaration & Definition of function – Built in function – User defined function -Types of functions – Call by value & reference.

Strings and Pointers: Formatting strings – String handling functions. Pointers: Features and Types of pointers – Arithmetic operations with pointers–Pointers and Arrays- Array of Pointers-Pointers and Strings

Structures and Union: Structures: Features – Operations on Structures – Array of structures – Pointers to Structures -Unions-Union of Structures.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Correlate the fundamental concepts of computer organization such as architectures of the processors and project management for real time application	Apply
CO2: Infer the fundamental concepts of programming, such as variables, data types and control structures for real time problems	Analyze
CO3: Apply programs solving skills and knowledge of C programming constructs to solve the given one dimensional and two dimensional datasets	Apply
CO4: Build a modules to solve the given application using functions	Apply
CO5: Develop a program by accessing the address of the variable using pointers and manipulation of characters using string handling functions	Apply
CO6: Test the performance of the students by group assignments and projects on real time problems	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	2	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	2	-	1	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	1	-	-	-	-	-	-	-	-	-	-
CO6	-	1	-	3	2	-	-	-	2	-	-	2	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Ashok N.Kamthane, Amit.N.Kamthane, “Programming in C”, 3rd Edition,Pearson Education, 2015.

T2. Deitel H M and Deitel P J, “C How to Program”, Prentice Hall, 2013.

Reference Book(s):

R1. Ajay Mittal, “Programming in C-A Practical Approach”, 3rd Edition, Pearson Education, 2010.

R2. Yashavant P.Kanetkar,” Let Us C” , 16th Edition, BPB Publications, 2018.

R3. Herbert Schildt, “C The Complete Reference", Tata McGraw Hill, 2010.

R4. S Gottfried Byron, “Programming With C”, Tata McGraw Hill, 2011.

Web References:

1. NPTEL course content on Introduction To Programming In https://onlinecourses.nptel.ac.in/noc22_cs40
2. Complete guide on Learn C programming: http://www.cprogramming.com/
3. Complete reference manual on C programming: http://www.c4learn.com/

Course Code:23ADL001	Course Title: C Programming Laboratory (Common to CE,EA,EC,EE & EV)		
Course Category: Multi-disciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 0:0:3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Course Objectives

The course introduces students to the practical knowledge of programming using C programming language as an implementation tool. It aims at providing students with understanding of programming essentials used within the framework of imperative and structural programming paradigms.

List of Experiments:

1. Implement basic C programs using data types
2. Implement programs using Operators and Expressions
3. Develop Programs using Branching statements
4. Implement Programs using Control Structures
5. Develop programs using Arrays
6. Implement programs using Functions
7. Implement programs using String Operations
8. Develop programs using Pointers
9. Implement programs using Structures
10. Develop programs using Union

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Write programs using appropriate programming constructs.	Apply
CO2: Apply programs solving skills and knowledge of C programming constructs to solve the given one dimensional and two dimensional dataset	Apply
CO3: Develop a program by accessing the address of the variable using pointers and manipulation of characters using string handling functions	Analyze
CO4: Evaluate modular programming techniques to break down complex programs into smaller and manageable modules	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	-	3	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO3	-	2	-	-	3	-	-	-	-	-	-	-	-	-
CO4	-	-	-	3	3	-	-	-	-	-	-	1	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. Ashok N.Kamthane,Amit.N.Kamthane, “Programming in C”, 3rd Edition, Pearson education, 2015.

T2. Deitel H M and Deitel P J, “C How to Program”, Prentice Hall, 2013.

Reference Book(s):

R1. Ajay Mittal, “Programming in C-A Practical Approach”, 3rd Edition, Pearson Education, 2010.

R2. Yashavant P.Kanetkar, “Let Us C”, 16th Edition, BPB Publications, 2018.

R3. Herbert Schildt, “C The Complete Reference", Tata McGraw Hill, 2010.

Web References:

1. C programming resources: https://electronicsforu.com/resources/15-free-c-programming-ebooks
2. C programming tutorials: https://www.fromdev.com/2013/10/c-programming-tutorials.html
3. C Manual: https://books.goalkicker.com/CBook

Course Code: 23VAL102		Course Title: Wellness for Students (Common to all B.E/B.Tech Programmes)	
Course Category: VAC		Course Level: Introductory	
L:T:P(Hours/Week) 0:0:2	Credits:1	Total Contact Hours:30	Max Marks:100

Course Objectives:
The course is intended to impart knowledge on setting SMART goals for academic, career and life, applying time management techniques, articulating the importance of wellness for success in life and understanding the dimensions of wellbeing and relevant practices.

Module I **15 Hours**

GOAL SETTING Understanding Vision and mission statements - Writing personal mission statements – 'Focus' as a way of life of most successful people. Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume. Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment.

TIME MANAGEMENT - TOOLS AND TECHNIQUES Importance of planning and working to time. Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying 'NO' – Managing procrastination.

CONCEPT OF WELLNESS – impact of absence of wellness - Wellness as important component to achieve success. Wellbeing as per WHO - Dimensions of Wellbeing: Physical, Mental, Social, Spiritual – indicators and assessment methods

Module II **15 Hours**

Simplified Physical Exercises. Fitness as a subset of Wellness – health related physical fitness - skill related physical fitness. Joint movements, Warm up exercises, simple asanas, WCSC simplified exercises.

PRACTICES FOR MENTAL WELLNESS

Meditation: Mind and its functions - mind wave frequency – Simple basic meditation – WCSC meditation and introspection tables. Greatness of friendship and social welfare – individual, family and world peace – blessings and benefits.
Food & sleep for wellness: balanced diet - good food habits for better health (anatomic therapy) – hazards of junk food - food and the gunas.

PUTTING INTO PRACTICE
Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Set well-articulated goals for academics, career, and personal aspirations	Apply
CO 2: Apply time management techniques to complete planned tasks on time	Apply
CO 3: Explain the concept of wellness and its importance to be successful in career and life	Apply
CO 4: Explain the dimensions of wellness and practices that can promote wellness	Apply
CO 5: Demonstrate the practices that can promote wellness	Valuing

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	1	1	-	1
CO2	-	-	-	-	-	-	-	-	1	-	1	1
CO3	-	-	-	-	-	-	-	-	1	-	-	1
CO4	-	-	-	-	-	-	-	-	1	-	-	1
CO5	-	-	-	-	-	1	1	-	1	-	-	1

High-3; Medium-2;Low-1

Text Book(s):

T1. Reading material, workbook and journal prepared by PS team of the college

Reference Book(s):

R1. Stephen R Covey, “First things first”, Simon & Schuster UK, Aug 1997

R2. Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster UK, 2004.

R3. Vethathiri Maharishi Institute for Spiritual and Intuitional Education, Aliyar, “Value education for harmonious life (Manavalakalai Yoga)”, Vethathiri Publications, Erode, I Ed. (2010).

R4. Dr. R. Nagarathna, Dr. H.R. Nagendra, “Integrated approach of yoga therapy for positive health”, Swami Vivekananda Yoga Prakashana, Bangalore, 2008 Ed.

R5. Tony Buzan, Harper Collins, “The Power of Physical Intelligence English”

Course Code: 23VAT101	Course Title: HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்ள இயலும்.

CO.2இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்ள இயலும்.

தமிழர் மரபு

அலகு 1 – மொழி மற்றும் இலக்கியம் 3

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் – சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் – பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு 2 – மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை 3

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள் – பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு 3 – நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் 3

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு 4 – தமிழர்களின் திணைக் கோட்பாடுகள் **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக் கோட்பாடு – சங்க காலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு 5 – இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு **3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறபகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுய மரியாதை இயக்கம் – இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப் படிகள்– தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 மொழி மற்றும் இலக்கியம், பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை , நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் , திணைக் கோட்பாடுகள் மூலம் தமிழர் மரபை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பை அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code: 23VAT101	Course Title: HERITAGE OF TAMILS (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.
2. Understand the Contribution of Tamils to Indian National Movement and Indian Culture.

HERITAGE OF TAMILS

UNIT I LANGUAGE AND LITERATURE 3

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III FOLK AND MARTIAL ARTS **3**

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV THINAI CONCEPT OF TAMILS **3**

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE **3**

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand the Heritage of Tamils in terms of Language and Literature, Rock Art Paintings to Modern Art – Sculpture, Folk and Martial Arts, Thinai Concept.	Understand
CO.2 Understand the Contribution of Tamils to Indian National Movement and Indian Culture.	Understand

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by:
Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

SEMESTER II

Course Code: 23ENI201		Course Title: Communication Skills II (Common to all B.E/B.Tech Programmes)	
Course Category: AEC		Course Level: Introductory	
L:T:P(Hours/Week) 2:0:2	Credits: 3	Total ContactHours:60	Max Marks:100

Course Objectives

The course is intended to impart effective and accurate language in business correspondence on par with B2 level of CEFR Scale.

20 Hours

Module I

Grammar: Linking Words - Collocations –Sentence Completion - Articles –Adverbs– Indefinite Pronoun

Listening: Listening to short conversations - Listening for gist and summarizing - Listening for detail - Responding to straightforward questions.

Speaking: Making statements of facts - Agreeing and disagreeing to opinions - Respond to queries - Group Discussion.

Reading: Read and select (phrasal verbs & relative clause)- Cloze Test - Gapped sentences - Multiple- choice gap-fill

Writing: Paragraph Writing: Descriptive, narrative, persuasive and argumentative - Emails: Giving information - Making enquiries - Responding to enquiries - Power Point Presentation

Module II **20 Hours**

Grammar: Expressions of cause and result – Concord - Error Spotting (Parts of Speech & Indian English) - Prepositions

Listening: Listening for identifying main points - Responding to a range of questions about different topics - Listening to identify relevant information

Speaking: Empathetic Enunciation – Situation handling – Visual Interpretation - - Short presentations

Reading: Intensive Reading: Comprehending business articles, reports and proposals and company websites-- Open gap-fill - Extended reading

Writing: – Report Writing - Memo – Complaint letter - Business Letters (Seeking permission & Providing Information)

List of Experiments: **20 Hours**

1. Listening to Monologue and Extended Listening Activity I
2. Listening to Monologue and Extended Listening Activity II
3. Expressing Opinions and Situational based speaking
4. Mini Presentation and Visual Interpretation
5. Reading Comprehension
6. Writing letter, email and report

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Identify the common errors in written and spoken correspondence.	Apply
CO2: Develop listening, reading and speaking skills through task based activities in listening, reading comprehension, recapitulation, interpretation and discussion.	Apply
CO3: Read business correspondences like memo, Email, letter, proposals and write reports and website entries and product launches.	Apply
CO4: Perform as an individual and member of a team and engage effectively in group discussion and individual presentation.	Apply

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	-	-	-
CO4	-	-	-	-	-	-	-	-	2	3	-	-	-	-

High-3; Medium-2;Low-1

Textbooks:

T1. Guy Brook- Hart, “Business Benchmark Upper Intermediate”, 2nd Edition, SouthAsian, Cambridge University Press, 2020.

T2. Norman Whitby, “Business Benchmark pre-intermediate to Intermediate”, 2nd Edition, South Asian, Cambridge University Press, 2014.

Reference Book(s):

R1. Hewings Martin - Advanced Grammar in use Upper-intermediate Proficiency, CUP,3rd Edition,2013.

R2. Clark David – Essential BULATS (Business Language Testing Service), CUP, 2006. R3. Adrian Doff, Craig Thaine, Herbert Puchta, Jeff Stranks, Peter Lewis-Jones, Rachel Godfrey,Gareth Davies, Empower B1+ – Student’s Book, Cambridge University Press,2015.

Web References:

1. https://speakandimprove.com/
2. https://writeandimprove.com/
3. https://www.cambridgeenglish.org/exams-and-tests/linguaskill/

Course Code:23FLT201	Course Title: FOREIGN LANGUAGE - JAPANESE (Common to all B.E/B.Tech Programmes)		
Course Category:AEC	Course Level: Introductory		
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course objectives intended to:

1. Express a basic exposure on Japanese language and culture
2. Express thoughts and communicate in the beginner level of Japanese with nativeJapanese speaker
3. Identify the kanji etymology as well as use it in basic vocabulary required for theJLPT/NAT 5 examination level
4. Read and write 100 kanji of the official JLPT N5
5. Choose the appropriate verb forms for learning and practicing the Japaneselanguage

UNIT I Introduction to Japan and greetings 9 Hours

Japan : Land and culture - Introduction to Japanese language – Greetings – Seasons - Days of the week - Months of the year – Dates of the month - Self introduction – Numbers (Upto 99,999) – Expressing time – Conversation audio and video.

Listening: Listening to Greetings - Listening for Specific Information: Numbers, Time.

Speaking: Self-Introduction

UNIT II Building vocabulary 9 Hours

Family relationships - Colours - Parts of body - Profession - Directions - Time expressions (today, tomorrow, yesterday, day before, day after) - Japanese housing and living style - Food and transport (vocabulary) - Stationery, fruits and vegetables

Listening: Listening for Specific Information: Directions, Family Members, Parts of body

Speaking: Introducing one's family.

UNIT III Writing systems 9 Hours

Hiragana Chart 1 - vowels and consonants and related vocabulary – Hiragana Charts 2&3, double consonants, vowel elongation and related vocabulary – Introduction to Kanji – Basic Vocabulary – Basic Conversational Phrases.

Listening: Listening to Japanese Alphabet Pronunciation, Simple Conversation.

Speaking: Pair Activity (Day to day situational conversation)

UNIT IV Kanji and preposition 9 Hours

Katakana script and related vocabulary – Basic kanjis: naka, ue, shita, kawa , yama , numbers (1- 10,100, 1000, 10,000 and yen) , person, man, woman, child, tree , book , hidari, migi, kuchi , 4directions - Usage of particles wa, no, mo and ka and exercises - Usage of kore, sore, are, kono, sono,ano, arimasu and imasu - Particles – ni (location) and ga ,

donata and dare - Particles ni (time), kara, made , ne , koko, soko, asoko and doko - Directions : kochira, sochira, achira and dochira , associated vocabulary (mae, ushiro, ue, shita, tonari, soba, etc.)

Listening: Listening to conversation with related particles

UNIT V Verb forms 9 Hours

Introduction to Verbs - Verbs –Past tense, negative - i-ending and na-ending adjectives introduction -
~masen ka, mashou - Usage of particles de, e , o, to, ga(but) and exercises - Adjectives (present/past – affirmative and negative) – Counters - ~te form
Listening: Listening to different counters, simple conversations with verbs and adjectives.
Speaking: Pair Activity (Explaining one's daily routine by using appropriate particles and verbs)

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Recognize and write Japanese alphabet	Understand
CO2: Comprehend the conversation and give correct meaning	Understand
CO3: Apply appropriate vocabulary needed for simple conversation in Japanese language	Apply
CO4: Apply appropriate grammar to write and speak in Japanese language	Apply
CO5: Speak using words of the Japanese language	Apply

Text Book(s):

T1. Genki 1 Textbook: An Integrated Course in Elementary Japanese by Eri Banno, Yoko Ikeda, Yutaka Ohno, Yoko Sakane, Chikako Shinagawa, Kyoko Tokashiki published by The Japan Times

T2. Genki 1 Workbook: An Integrated Course in Elementary Japanese by Eri Banno published by The Japan Times

Reference Book(s):

R1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007

R2. Japanese for Everyone: Elementary Main Textbook1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007

Web References:

1. www.japaneselifestyle.com
2. www.learn-japanese.info/
3. www.learn.hiragana-katakana.com/typing-hiragana-characters/
4. www.kanjisite.com/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	1	-	-

High-3; Medium-2; Low-1

Course Code:23FLT202	Course Title: FOREIGN LANGUAGE - GERMAN (Common to all B.E/B.Tech Programmes)		
Course Category: AEC		Course Level: Introductory	
L:T:P (Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max. Marks:100

Course Objectives:

The course is intended to:

1. Listen and understand numbers, names and dialogues of a native speaker on par with A1 level.
2. Speak and introduce self in simple sentences to convey their opinion and ideas on par with A1 level.
3. Read simple passages and given text on par with A1 level.
4. Write letter and simple sentences on par with A1 level.

UNIT I BASIC INTRODUCTION TO GERMAN SCRIPTS 9

Theme and Text (Introduction to German - German script, Deutsche Namen, Daily Greetings and Expressions) – Grammar ('wh' questions, das Alphabet)– Speak Action (Buchstabieren, sich und andere vorstellen nach Namen und Herkunft fragen, internationale Wörter auf Deutsch verstehen, jemanden begrüßen)– pronunciation (Buchstabieren J,V,W,Y, - Long vowels A,E,I,O,U - Pronunciation of Ä,Ü,Ö) – To learn (internationale Wörter in Texten finden, Wörter sortieren) Theme and Text (Gespräche im caf'e, Getränkekarte, Telefon-buch, Namen, Rechnungen) –Grammar (Frägesatze mit wie, woher, wo, was Verben in präsens Singular und Plural, das Verb Sein, Personalpronomen und Verben)– Speak Action (eine Gespräch beginnen sich und andere vorstellen zählen, etwas bestellen und bezhalen Telefonnummern und verstehen)– pronunciation (Wortakzent in Verben und in Zahlen) – To learn (Grammatiktabelle ergänzen, mit einem Redemittelkasten arbeiten)

UNIT II NUMBERS AND NOMINATIVE CASE 9

Theme and Text (Numbers – 1 to 12 (Eins bis Zwolf) – 20, 30, 40, 90 (zwanzig-Neunzig) – All Numbers (1-10000) – German Currency (Euro) – Basic Mathematics (plus, Minus, Malen, Geteilt durch)) – Grammar (Introduction of verbs –Have Verb – To Come, To Speak, To Read, To Drive, To Fly, To write, To Eat, To sleep, To take etc.,) Theme and Text (Communication in course) – Grammar (Singular and Plural, Artikel: der,das,die/ ein,eine, verneinung: kein, keine, Komposita: das Kursbuch) – Speak Action (Gegenständen

fragen/ Gegenstände benennen im kurs:) – pronunciation (word accent Marking, Umlaute ö ä ü hören und sprechen) – To learn (Lernkarten schreiben, Memotipps, eine Regel selbst finden) Theme and Text (City, Town, Language: Nachbar, Sprachen, Sehenswürdigkeiten in Europa) – Grammar (Past tense for Sein, W-Frage, Aussagesatz und Satzfrage) – Speak Action (about city and siteseeing) – pronunciation (Satzakzent in Frage- und Aussagesätzen) – To learn (eine Regel ergänzen, eine Grammatiktabelle erarbeiten, Notizen machen)

UNIT III AKKUSATIVE CASE AND PREPOSITIONS 9

Theme and Text (Menschen und Hauser, Furniture catalogue, E-Mail, House information) – Grammar (possesivartikel im Nominativ, Artikel im Akkusativ, Adjektive im satz, Graduierung mit zu)– Speak Action (Whonung bescreiben about perons and things)– pronunciation (consonant-ch) – To learn (wortschatz systematisch)

Theme and Text (Termine - Appointment and punctuality in Germany) – Grammar (questions with wann?, Preposition (am, um, von. bis), verneinung mit nicht, trennbare verben, präteritum von haben) – Speak Action (Daily plan making, time commitment, excuse for late coming) – pronunciation (consonants- p,b,t,d / k,g) – To learn (Rollenkarten arbeiten)

Theme and Text (orientation in working area, go for work, floor plan city plan, office and computer) – Grammar (preposition: in,neben, unter, auf, vor, hinter, an, zwischen, bei und mit + Datic)– Speak Action (work place, work, giving appointments)– pronunciation (consonants: f,w und v) – To learn (Making notice in calender)

UNIT IV DATIV CASE AND PREPOSITIONS 9

Theme and Text (Holiday and Party, holiday plan, party plan in Germany) – Grammar (regular and iregular verbs) – Speak Action (holiday speak, accident, Ich-Text schreiben) – pronunciation (lange und kurze vokale markieren) – To learn (Text Order)

Theme and Text (organising an Excursion to Berlin through city orientation, Bus plan, City plan, post card, Excursion programme) – Grammar (preposition: in, durch, über + Akkusativ: zu, an... vorbei + Dativ, Modalverb wollen) – Speak Action (Tourism, culture, postcard preparation, travel description) – pronunciation (r and l)– To learn (plaket making)Theme and Text (Beruf und all Tag, Visiten karten, wörterbuch) – Grammar – Speak Action (profession, statistic speaking) – pronunciation (n,ng and nk)– To learn (wörterbuch , text information in tabel)

UNIT V ADJECTIVES AND PRONUNCIATION 9

Theme and Text (Haushaltstipp, kochrezept, maße und gewichte, Mahlzeiten und Gerichte) – Grammar (jeden Tag, manchmal, nie, Question - welche, Comparison – viel, gut, gern) – Speak Action (about eat, drink question and answers) – pronunciation (e,en,el,er) – To learn (Text

auswerten und zusammenfassen)

Theme and Text (Clothing , colour, weather) – Grammar (Adjecktive im Akkusativ, unbestimmer Artikel) – Speak Action (weather, dress and colour understanding) – pronunciation (e-o- ö and ie-u-ü) – To learn (wetter and Farben interkulturelle)

Theme and Text (in super market,purchase, House Maintainence, Emotion, Sports, Body parts)– Grammar (Modal Verb) – Speak Action (Body parts) – To learn (Rollenkarten arbeiten)

Total:45 Hours

Course Outcomes **At the end of this course, students will be able to:**	**Cognitive Level**
CO1: Recognize and write German alphabet, numbers.	Understand
CO2: Comprehend the conversation and give correct meaning	Understand
CO3: Apply appropriate grammar and vocabulary to write and speak.	Apply
CO4: Apply appropriate cases and texts to listen, write and speak.	Apply
CO5: Speak and read using words of the German language	Apply

Text Book (s):

T1. Netzwerk, “Deutsch als Fremdsprache” by Stefanie Dengler, Paul Rusch, Helen Schmitz published

T2. Funk, Kuhn, Demme, “Studio D A1 Deutsch als Fremdsprache” published by Goyal Publishers &Distributors Pvt Ltd;

Reference Book(s):

R1. Hueber, “Fit for Goethe- Zertifikat A1 (Start Deutsch 1)” by Goyal Publishers and Distributors; 2016

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO4	-	-	-	-	-	-	-	-	-	3	-	1	-	-
CO5	-	-	-	-	-	-	-	-	2	3	-	1	-	-

High-3; Medium-2;Low-1

Course Code: 23MAI202		Course Title: Complex Variables and Transforms (Common to AU, EC, EE, EV & ME)	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week) 3:0 :2	Credits: 4	Total Contact Hours:75	Max Marks:100

Course Objectives:

This course is intended to enable the student to acquire the knowledge on the calculus of functions of complex variables and continuous, discrete transforms.

Module I **23 Hours**

Vector Calculus

Gradient – Divergence – Curl – Line integrals – Surface integrals – Volume integrals – Theorems of Green, Gauss and Stokes (without proof) and their applications.

Complex Variables (Differentiation)

Cauchy-Riemann equations – Analytic functions – Properties – Harmonic functions – Finding harmonic conjugate – Conformal mapping (w=z+a, w= az, w=1/z,) – Mobius transformation and their properties.

Complex Variables I (Integration)

Cauchy Integral formula – Cauchy Integral theorem – Taylor's series – Singularities of analytic functions – Laurent's series.

Module II **22 Hours**

Complex Variables II (Integration)

Residues – Cauchy Residue theorem – Contour integrals – Evaluation of real definite integrals around unit circle and semi-circle (Excluding poles on the real axis).

Laplace Transform

Laplace Transform – Properties of Laplace Transform – Laplace transform of derivatives and integrals – Laplace transform of periodic functions -Inverse Laplace transforms - Convolution theorem – Solution of ordinary differential equations by Laplace Transform method.

Fourier Series

Dirichlet's condition -Fourier series – Even and odd functions- Half range sine and cosine series - Parseval's identity--Harmonic Analysis.

List of Experiments (Using Python): **30 Hours**

1. Find gradient of a given scalar function, divergence and curl of a vector function.
2. Verify Green's theorem in a plane.
3. Graphically plot time and frequency domain of standard functions and compute Laplace transform of In- built functions.
4. Find the Fourier series of a periodic function.
5. Compute Inverse Laplace transform of In- built functions.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Explain the concepts of Vector Differentiation and Integration.	Apply
CO2: Using the concept of complex variables to construct analytical functions and evaluate definite integrals.	Apply
CO3: Apply Laplace transform techniques to solve ordinary differential equations.	Apply
CO4: Compute the Fourier series expansion for given periodic functions.	Apply
CO5: Develop programs using Complex Variables and Transforms concepts through modern tool.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	-	-	3	-	-	-	-	-	-	-	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Erwinkreyzig, Advanced Engineering Mathematics, 10th edition, John Wiley& Sons, 2011.

T2. Veerarajan T., Engineering Mathematics for first year, 3rd edition, Tata McGraw-Hill, New Delhi, 2019.

Reference Book(s):

R1. G.B.Thomas and R.L Finney, Calculus and Analytic Geometry, 9th edition, Pearson, Reprint, 2002.

R2. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 36th Edition, 2010.

R3. P. Sivaramakrishna Das , C. Vijayakumari , Engineering Mathematics, Pearson India, 2017.

Web References:

1. https://nptel.ac.in/courses/111107112
2. https://nptel.ac.in/courses/111104031

Course Code: 23PHI201		Course Title: Physics for Electrical Sciences (Common to EA, EC, EE & EV)	
Course Category: Minor		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 2	Credits: 4	Total Contact Hours:75	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on the fundamental laws and relations in electricity, magnetism, electromagnetism and electromagnetic waves.

Module I **22 Hours**

Electrostatics: Definition of electric charge-Coulomb's Law – Electric field intensity – Field intensity due to point and line charges – Electric flux density -Gauss's law- Application of Gauss's law: Determine the field due to a line charge and a plane sheet of charge – Electric potential-Equipotential surfaces-Potential gradient.

Magnetostatics: Definition of magnetic flux- magnetic field intensity-Lorentz Law offorce-Biot – Savart law, Ampere's Law- Application of Ampere's Law: Magnetic induction due to a long linear conductor and solenoid - Magnetic field due to straight conductors- circular loop – Magnetic flux density (B) - Magnetic potential.

Electric Fields in Materials: Dielectrics: An atomic view - Dielectric Polarization-Dielectrics and Gauss's law- Dielectric Strength- Energy stored in a dielectric medium - Capacity of a condenser - Capacitance - coaxial, Spherical capacitor- Poisson andLaplace Equation.

Module II **23 Hours**

Magnetic Fields in Materials: Magnetic susceptibility and permeability- properties of dia, para and ferro magnetic materials-hysteresis loop.

Electromagnetic Induction: Faraday's law – Lenz's law – Time varying magnetic field - self Inductance - self Inductance of a solenoid- Mutual inductance- Mutual inductance of two solenoids. Charge conservation law - continuity equation- displacement current-Maxwell's equations.

Electromagnetic Waves: Electromagnetic waves in free space - Poynting vector - Propagation of electromagnetic waves in dielectrics – Phase velocity- Propagation of electromagnetic waves through conducting media- penetration or skin depth.

List of Experiments (Any six) **30 Hours**

1. Verification of Ohms' law.
2. Test the Faraday's hypothesis of magnetic field induction.
3. Determination of specific resistance of the given material using Carey foster's bridge.
4. Measurement of capacitance using Schering Bridge.
5. Measurement of inductance using Maxwell Bridge.
6. Determination of wavelength of the given light source using spectrometer.
7. Determination of Dielectric constant of a given Material.

Course Outcomes	**Cognitive Level**
At the end of the course students will able to	
CO1: Apply the concepts of static electric and magnetic fields to obtain the electric and magnetic characteristics of the materials.	Apply
CO2: Interpret the behavior of materials in electric and magnetic fields.	Apply
CO3: Apply the concept of time-varying electric and magnetic fields to obtain the propagation characteristics of electromagnetic waves in different media.	Apply
CO4: Conduct, analyze and interpret the data and results from the physics laboratory experiments.	Evaluate

Course Articulation Matrix

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1. R.K.Gaur and S.L.Gupta, “Engineering Physics”, Dhanpat Rai publications, New Delhi, 8th Edition, 2011.

T2. W. H. Hayt and John A. Buck, “Engineering Electromagnetics”, Tata McGraw Hill, New Delhi, 6th Edition, 2014.

Reference Book(s):

R1. David Griffiths, “Introduction to Electrodynamics”, Pearson Education, 4th Edition, 2013

R2. K. A. Gangadhar and P. M. Ramanathan, “Electromagnetic Field Theory”, Khanna Publishers, New Delhi, 5th Edition, 2013.

R3. Mathew. N. O. Sadiku, “Elements of Electromagnetics”, Oxford University Press, 4th Edition, 2009.

Web References:

1. http://nptel.iitm.ac.in
2. http://openems.de/start/index.php
3. https://bop-iitk.vlabs.ac.in/List%20of%20experiments.html

Course Code: 23ECT001		Course Title: Circuit Theory (Common to EA ,EC&EV)	
Course Category: Major		Course Level: Introductory	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to impart knowledge of the fundamentals of Electric circuits and its analysis.

Module I **23 Hours**

Fundamentals of Electric Circuits: Ohm's law - Kirchoff's Laws –Series resistive circuit- Voltage division rule- Parallel resistive circuit – Current division rule– Source transformation – Star to delta and delta to star transformation

Time period, Frequency, Angular frequency, Average value, Root mean square value, Form factor and Peak factor of sinusoidal.

Analysis of DC and AC Circuits: Mesh and node method of analysis - Networks theorem: Superposition Theorem, Thevenin's Theorem, Norton's theorem and Maximum power transfer theorem.

Module II **22 Hours**

Resonance and Coupled Circuits: Series resonance-Voltage and Current in a series resonance, Impedance and phase angle. Parallel resonance-Resonant frequency - Variation of Impedance with frequency Coupled circuits- mutual inductance, Coefficient of coupling.

Transient Response of Networks: Steady state and Transient response - Response of an R-L, R-C and R-L-C circuits under DC excitation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Define, understand, and explain the various laws for analyzing Electric circuits.	Understand
CO2: Apply the knowledge of network laws and theorems to the given electric circuit to obtain the required parameters.	Apply
CO3: Analyze the resonance and transient behaviour of the given electric circuit using appropriate mathematical tools.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	1	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1.Sudhakar A, Shyammohan S. Pillai "Circuits and Networks -Analysis and Synthesis", McGraw Hill., New Delhi, 2015

Reference Book(s):

R1. William H. Hayt and Jack E. Kemmerly, “Engineering Circuit Analysis ", McGraw Hill International Edition, 2006

R2. Singh "Network Analysis and Synthesis", McGraw-Hill Education., New Delhi, 2013

R3. M. Arumugham and N.Prem kumar, “Electric Circuit Theory”, Khanna publishers, 2010

R4. Alexander C, Sadiku M. N. O "Fundamentals of Electric Circuits", Tata McGraw Hill., New Delhi, 2013

Web References:

1. http://nptel.ac.in/video.php?subjectId=108102042
2. http://nptel.ac.in/courses/108102042/
3. http://nptel.ac.in/courses/108105053/
4. http://freevideolectures.com/Course/2336/Circuit-Theory/

Course Code: 23ITT202		Course Title: Problem solving and Python Programming (Common to EA, EC & EV)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The objective of the course is to introduce learners to the fundamentals of programming usingthe Python language. The course aims to equip participants with the necessary skills and knowledge to write efficient, readable, and maintainable Python code.

Module I **23 Hours**

Basics of Python: Features - Variables and Data Types - Expressions and Statements - Operators.

Control Flow: Conditional Statements – Looping and Iterative Statements

Functions and File Handling: Introduction to Functions - Recursive Functions - Introduction to Files and File Handling

Data Structures in Python: Lists: Functions and Methods - Tuples: Operations and Built-in Functions - Sets: Functions and Methods - Dictionaries: Functions and Methods - Strings: Operators and Built-In String Functions

OOP Concepts: Classes and Objects: Modifiers in Classes - Method Invocation in Classes - Inheritance and Polymorphism.

Module II

22 Hours

Exception Handling: Errors and Exceptions

GUI Programming with TKinter: GUI Basics - Working with the TKinter Library

Widgets and Events: Adding Widgets and Binding Events - Message and Entry Widgets -Checkboxes and Radio Buttons - Menus and Lists - Canvas for Drawing

Data Visualization with Matplotlib: Introduction to Matplotlib Library - Line and Bar Plots -Scatter Plots - Pie Charts - Working with Multiple Figures - 3D Plots - Plotting Using Files.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply Python programming constructs and data structure techniques to solve practical problems and build functional applications.	Apply
CO2: Categorize the OOPs concepts to create modular and extensible Python programs.	Analyze

CO3: Infer the errors and exceptions in Python programs using exception handling techniques to ensure robust and fault-tolerant code	Analyze
CO4: Build graphical user interfaces (GUIs) using TKinter, effectively incorporating various widgets and event binding to create interactive and visually appealing applications	Apply
CO5:. Employ the Matplotlib library for data visualization to present data and insights in a visually impactful method	Apply
CO6: Combine the Python language features and libraries to provide solutions collaboratively with Ethical values to the practical problems	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-
CO6	-	-	3	2	2	-	-	3	3	3	3	3

High-3; Medium-2; Low-1

Text Book(s):

T1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey, and Chris Meyers, “How to Think Like a Computer Scientist: Learning with Python”,3rd Edition, O’Reilly, 2020.

T2. Mark Lutz, “Powerful Object-Oriented Programming Python”, 4th Edition, O’Reilly, 2013.

Reference Book(s):

R1. Mark Lutz, “Learning Python, Powerful OOPs”, 5th Edition, O’Reilly, 2013.

R2. Zelle, John M, “Python Programming: An Introduction to Computer Science”, Franklin Beedle& Associates, 2003.

Web References

1. https://docs.python.org/3/tutorial/
2. https://www.learnpython.org/
3. https://www.pyschools.com/
4. https://archive.nptel.ac.in/courses/106/106/106106182/

Course Code: 23MEL001		Course Title: ENGINEERING DRAWING (Common to AD,AM,AU,CS,EA ,EC,EE,EV,IT,ME, SC)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 1: 0: 3	Credits:2.5	Total Contact Hours: 60	Max Marks:100

Course Objectives:

The course is intended to

- To impart knowledge on basic dimensioning. 2D and 3 D drawings such as points, lines, planes and solids on first quadrant.

Module I **8 Hours**

Basics of Engineering Drawing: Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. Basic Geometrical constructions –Orthographic projection-Free hand Sketching.

Projection of Points, Lines: First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces by rotating object method.

Projection of Solids: Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by rotating object method. Practicing three dimensional modeling of simple objects by CAD Software (Not for examination).

Module II **7 Hours**

Sectioned Solids: Sectioning of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by cutting planes inclined to one reference plane and perpendicular to the other – Orthographic views of sections of simple solids.

Development of Surfaces: Development of lateral surfaces of simple and truncated solids – Prisms,pyramids, cylinders using straight line and radial line method.

Isometric Projection: Principles of isometric projection – Isometric scale –Isometric projections of simple solids and truncated solids. Practicing three dimensional modeling of isometric projection of simple objects by CAD Software (Not for examination).

List of Experiments **45 Hours**

1. Lettering & Dimensioning
2. Projection of Points & Lines
3. Orthographic projections
4. Projection of Simple Solids
5. Projection of Section of Simple Solids
6. Development of Surfaces
7. Isometric Projections

Course Outcomes:

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Apply the concepts related to free hand sketching, orthographic and Isometric projection in first quadrant.	Understand
CO2: Apply the concepts and draw projections of points in four different quadrants and lines located first quadrant.	Apply
CO3: Apply the concepts and draw projections and sections of simple solids using rotating object method.	Apply
CO4: Apply the concepts and draw lateral surface of simple solids using straight line and radial line development methods.	Apply
CO5: Apply the concepts and draw isometric view of simple solids and truncated solids using principles of isometric projection.	Apply
CO6: Conduct experiments to demonstrate concepts, implement and analyze the drawing concepts using engineering tool: Using AutoCAD.	Analyze

Text Book(s):

T1. Cencil Jensen, Jay D.Helsel and Dennis R. Short, " Engineering Drawing and Design", Tata McGraw Hill India, New Delhi, 3rd edition, 2019.

Reference Book(s):

R1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill India, New Delhi, 2nd edition, 2014.

R2. Dhananjay A. Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw India, New Delhi, 3rd edition, 2010.

R3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", Charotar Publishing House, Gujarat, 54rd edition, 2023.

PUBLICATIONS OF BUREAU OF INDIAN STANDARDS

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
2. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
3. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods. The mode of delivery is like practical.

Web References:

1 http://nptel.ac.in/courses/112103019/

2 https://www.coursera.org/specializations/autodesk-cad-cam-cae-mechanical-engineering

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO6	-	3	-	-	3	-	-	-	1	1	-	1	-	-

High-3; Medium-2; Low-1

Course Code: 23ECL001	Course Title: Electric Circuits and Electron Devices Laboratory (Common to EA, EC & EV)		
Course Category: Major		Course Level: Introductory	
L:T:P (Hours/Week) 0:0:3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to verify the electric circuit, network theorems and characteristics of the basic electronic devices.

List of Experiments:

1. PN Junction Diode and Zener diode Characteristics
2. Half wave and Full wave Rectifier circuits
3. Regulator using Zener diode
4. Wave shaping circuits: Clippers and clampers
5. Characteristics of Common Emitter configuration
6. Characteristics of Common Base configuration
7. FET characteristics and its application as a switch
8. Verification of Kirchhoff's Voltage and Current laws
9. Verification of Super Position Theorem
10. Verification of Thevenin's and Norton's theorems
11. Verification of Maximum Power transfer theorem
12. Determination of Resonance frequency of Series & Parallel RLC Circuits

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Conduct experiments to verify the characteristics of devices and theorems for Electric circuits.	Evaluate
CO2: Compare the experimental results obtained during verification of network theorems with simulation results.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	3	-	-	-	-	1	1	-	-	-	-
CO2	-	3	-	-	3	-	-	-	-	-	-	1	1	-

High-3; Medium-2; Low-1

Reference:

1. Laboratory Manual Prepared by Faculty of Electronics and Communication Engineering, Dr. Mahalingam College of Engineering and Technology.

Course Code: 23ESL201		Course Title: Professional Skills 1: Problem solving skills & Logical Thinking 1 (Common to all B.E/B.Tech Programmes)	
Course Category: SEC		Course Level: Introductory	
L:T:P(Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objectives:

To enhance the students' numerical, analytical and logical reasoning ability.

To make them prepare for various public and private sector exams and placement drives.

Module I Quantitative Ability 20 Hours

Number System and LCM & HCF- Percentage- Ratio and Proportion - Average- Progressions- Ages-Partnership- Mixture & Allegation - Profit and loss- Interest calculation- Data interpretation.

Module II Reasoning Ability 10 Hours

Seating Arrangement- Linear, circular and Complex – Direction Problems- Blood Relation- Puzzles- Crypt arithmetic- Venn diagrams- Statement and conclusion- Statement and argument- Causes and effects- Self-Learning.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Build the competence in numerical, analytical and logical Reasoning ability	**Apply**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	-	-

High-3; Medium-2; Low-1

Textbook(s):

T1: Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018.

T2: Dr. R. S. Aggarwal. “A Modern Approach to Logical Reasoning”, Sultan Chand & Sons Pvt. Ltd, New Delhi, 2018

Reference Book(s):

R1: R. V. Praveen. “Quantitative Aptitude and Reasoning” 2nd Revised Edition, Prentice-Hall of India Pvt.Ltd, 2013

R2: Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, McGraw Hill Publications, 5th Edition, 2020

R3: Arun Sharma. “Logical Reasoning for Common Aptitude Test”, McGraw Hill Publications, 6th Edition, 2021.

Web References:

1 https://www.indiabix.com/aptitude/questions-and-answers/

2 https://www.geeksforgeeks.org/aptitude-questions-and-answers/

Course Code: 23VAT201	Course Title: TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

மாணவர்கள் இப்பாடத்தை கற்றலின் மூலம்

CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்ள இயலும்.

CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்ள இயலும்.

தமிழரும் தொழில்நுட்பமும்

அலகு 1 – நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் – கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்

அலகு 2 – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் ஷ சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு – சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் – மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் – மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள், பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ – சாரோசெனிக் கட்டிடக் கலை.

அலகு 3 – உற்பத்தித் தொழில்நுட்பம் 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத் துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு 4 வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன் வளம் – முத்து மற்றும் முத்துக் குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு 5 – அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் 3

அறிவியல் தமிழின் வளர்ச்சி – கணினித் தமிழ் வளர்ச்சி – தமிழ் நூல்களை மின் பதிப்பு செய்தல் – தமிழ் மென் பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக் கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
மாணவர்கள் இப்பாடத்தை கற்றபின்	
CO.1 நெசவு மற்றும் பானைத் தொழில்நுட்பம், வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம், உற்பத்தித் தொழில்நுட்பம், வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் ஆகியன குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)
CO.2 அறிவியல் தமிழ் மற்றும் கணினித் தமிழ் குறித்து அறிந்து கொள்வார்கள்.	அறிதல் (Understand)

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code: 23VAT201	Course Title: TAMILS AND TECHNOLOGY (Common to all B.E/B.Tech Programmes)		
Course Category: VAC		Course Level: Introductory	
L:T:P (Hours/Week) 1: 0 :0	Credit: 1	Total Contact Hours: 15	Max Marks:100

Pre–requisites

- NIL

Course Objectives

The course is intended to:

1. Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.
2. Understand the Scientific Tamil & Tamil Computing.

TAMILS AND TECHNOLOGY

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III MANUFACTURING TECHNOLOGY 3

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel -Copper and gold- Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV AGRICULTURE AND IRRIGATION TECHNOLOGY 3

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V SCIENTIFIC TAMIL & TAMIL COMPUTING 3

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

TOTAL : 15 PERIODS

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO.1 Understand Weaving and Ceramic Technology, Design and Construction Technology, Manufacturing Technology, Agriculture and Irrigation Technology.	Understand
CO.2 Understand the Scientific Tamil & Tamil Computing.	Understand

Course Articulation Matrix

CO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	-	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	-	-	-	-	-	-	-	-	-	-	-	1	-	-

High–3; Medium–2; Low–1

TEXT - CUM REFERENCE BOOKS

1 தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே.பிள்ளை
(வெளியீடு. தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)

2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)

3. கீழடி – வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)

4. பொருநை – ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)

5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.

7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).

8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)

9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

Course Code: 23CHT202		Course Title: Environmental Sciences (Common to all B.E/B.Tech Programmes)	
Course Category: Multidisciplinary		Course Level: Introductory	
L:T:P(Hours/Week) 1: 0: 0	Credits: Mandatory Non-Credit Course	Total Contact Hours: 15	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on sustainable utilization of natural resources, prevention of pollution, disaster management and environmental issues & public awareness on ecosystem.

Module I **8 Hours**

Natural Resources

Role of individual in conservation of natural resources; Equitable use of resources for sustainable lifestyles.

Environmental Pollution and Disaster Management

Role of an individual in prevention of pollution; Disaster management : floods, earthquake, cyclone and landslides.

Environmental Ethics and Legislations

Environmental ethics : Environment Protection Act; Air Act; Water Act ; Wildlife Protection Act; Forest Conservation Act; Issues involved in enforcement of environmental legislation.

Module II **7 Hours**

Environmental Issues and Public Awareness

Public awareness - Environment and human health.

Environmental Activities

(a) Awareness Activities:

i. Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste.
ii. Slogan making event.
iii. Poster making event.

(b) Actual Activities:

i. Plantation.
ii. Cleanliness drive.
iii. Drive for segregation of waste.
iv. To know about the different varieties of plants.
v. Shutting down the fans and ACs of the campus for an hour or so.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Explain the use of natural resources for a sustainable life as an individual in prevention of pollution.	Understand
CO 2: Apply the environmental ethics and legislations for various environmental issues.	Apply
CO 3: Create the public awareness on environment and human health as an individual or team through various activity based learning.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	3	3	-	-	-	-
CO3	3	-	-	-	-	3	3	-	3	3	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Benny Joseph, “Environmental Studies", Tata McGraw Hill, New Delhi, 2006.

T2. Mackenzie Davis and Susan Masten, “Principles of environmental engineering and science”, Mc-Graw Hill, 3rd Edition, 2014.

Reference Book(s):

R1. Trivedi R.K. “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol.I and II, Enviro Media.

R2. Cunningham, W.P.Cooper, T.H. Gorhani, “Environmental Encyclopedia", Jaico Publishing House, Mumbai, 2001.

Web References:

1. https://onlinecourses.nptel.ac.in/noc23_hs155/preview.
2. https://en.wikipedia.org/wiki/Environmental_science.

SEMESTER III

Course Code: 23MAI301		Course Title: Numerical Techniques and Linear Algebra	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week) 3:0 :2	Credits: 4	Total Contact Hours:75	Max Marks:100

Course Objectives:

This course is designed to give an overview of numerical methods and provide knowledge and skills needed to apply these tools and techniques for decision making in various fields of science and engineering.

Module I **23 Hours**

Solution of System of Linear Equations and Eigenvalue

Solution of system of linear equations– Direct methods: Gaussian elimination method – Indirect methods: Gauss Jacobi method, Gauss-Seidel method– sufficient conditions for convergence –Solution of nonlinear equations: Newton Raphson method – Power method to find the dominant Eigen value and the corresponding Eigen vector – Application of Eigen value and the corresponding Eigen vector.

Interpolation, Numerical Differentiation and Integration

Interpolation – Newton's forward, backward interpolation – Lagrange's interpolation. Numerical Differentiation and Integration – Trapezoidal rule – Simpson's 1/3 rule – Double integration using Trapezoidal rule.

Numerical Solution of Ordinary Differential Equation

Numerical solution of first order ordinary differential equation-Single step method: Taylor's series- Euler's method – Runge-Kutta method of fourth order – Multi step method: Milne's predictor corrector methods for solving first order differential equations.

Module II **22 Hours**

Vector Spaces

Vector spaces- Subspace of a vector space- basis and dimension of vector space – linear combination and spanning sets of vectors – linear independence and linear dependence of vectors – Row space, Column space and Null space – Rank and nullity of subspaces.

Orthogonality and Inner Product Spaces

Inner product of vectors: length of a vector, distance between two vectors, and orthogonality of vectors – Orthogonal projection of a vector – Gram-Schmidt process to produce orthogonal and orthonormal basis – Inner product spaces.

List of Experiments: **30 Hours**

1. Use python to solve system of linear equations using Gauss elimination method.
2. Use python to solve algebraic and transcendental equation by Newton Raphson method.
3. Use python to interpolate using Newton's forward and backward interpolation method.
4. Use python to solve first order ordinary differential equation using Range kutta method of 4^{th} order.
5. Use python to find the basis of row space, column space and null space of a given matrix.
6. Use python to compute the inner product of two vectors and to check whether the given vectors are orthogonal.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Solve the system of linear equations, nonlinear equations & calculate the dominant Eigen value	Apply
CO2: Determine the unknown values from the given set of data & Compute derivatives and integrals.	Apply
CO3: Solve first order ordinary differential equation using Numerical Techniques.	Apply
CO4: Apply the concept of vector spaces and inner product spaces to produce orthogonal and orthonormal basis.	Apply
CO5: Apply the concepts of Numerical techniques and Linear Algebra to electrical and electronics engineering.	Apply
CO6: Apply the concepts of Numerical techniques using modern tools and report the result and inference. (For laboratory content only)	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	1	-	-
CO5	2	-	-	-	-	-	-	-	-	1	-	1	-	-
CO6	-	-	-	-	3	-	-	-	1	-	-	1	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Grewal, B.S. and Grewal, J. S., “Numerical Methods in Engineering and Science”, Eleventh Edition, Khanna Publishers, New Delhi, 2013.

T2. Curtis F. Gerald, Patric.O. *W*heatley, “Applied Numerical Analysis”, Seventh Edition, Pearson Education, Asia, New Delhi, 2009.

Reference Book(s):

R1. Steven Chopra, Raymond.P. Canale, “Numerical Methods for Engineers”, Seventh Edition, 2015.

R2. Jain M.K, lyengar.S.R. K and Jain.R. K, “Numerical Methods for Scientific and Engineering Computation”, Sixth Edition, New Age Publishers, 2012.

R3. Gilbert Strang, “Linear algebra and its applications”, Fourth Edition, Cengage Learning(RS), 2012.

Web References:

1. http://nptel.ac.in/courses/122104018/node2.html
2. http://nptel.ac.in/courses/111105038

Course Code: 23EVT301		Course Title: Digital Electronics	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to teach Boolean laws, simplification techniques and implement the same to design combinational, synchronous sequential, and asynchronous sequential circuits. Moreover, the course imparts a knowledge on the design of various memory devices, shift registers.

Module I **23 Hours**

Boolean Algebra: Basic theorems, Representation of Boolean function in canonical and standard forms- Karnaugh Map – Quine McClusky minimization technique (4-variable), Basic gates, Universal realisation.

Logic Families: -Introduction - TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, CMOS- NAND, NOR realization.

Combinational logic circuits: Half adder – Full Adder – Half subtractor - Full subtractor – Parallel binary adder - 2's complement subtraction using parallel adders - Multiplexer/Demultiplexer – decoder - encoder - code converters - Magnitude Comparator.

Module II **22 Hours**

Synchronous Sequential Circuits: Flip-flop and Latch: SR latches - JK flip-flop, T flip-flop, D flip-flop-Master-slave JK flip-flop- Shift registers (SISO, SIPO, PISO, PIPO)-Universal shift register-Counters: - Mealy and Moore model – Design of Synchronous Counters-Modulus-n Counter -Up-Down counter- State Reduction- State assignment

Asynchronous Sequential Circuits: Analyze and design of asynchronous sequential circuits, Asynchronous/Ripple counters - FSM - Sequence detector - Vending Machine.

Memory and Logic Devices: RAM Memory decoding-ROM - Basic concepts: - Programmable Logic Devices (PLDs): Basic concepts - PROM as PLD-Programmable Array Logic (PAL) - Programmable Logic Array – Case Studies on Digital system design.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Develop the combinational circuits using logic gates implementing Boolean simplification	Apply
CO 2: Design the synchronous sequential circuits using basic Flip Flops	Apply
CO 3: Analyze the asynchronous sequential circuits for the given application	Analyze
CO 4: Apply the basic digital concepts in memory devices, and logic devices and present acase study as a team or individual.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	-	-	3	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	3	-	-	-	-	-	-	-	1	1	-	-	1	1

High-3; Medium-2;Low-1

Text Book(s):

T1. A.Anandkumar,"Fundamentals of digital circuits", 4th Edition, PHI Learning Pvt Ltd, 2016

T2. John F.Wakerly, "Digital Design Principles and Practice", Pearson Education,5th edition, 2018.

Reference Book(s):

R1.Malvino and Leach, "Digital Principles and Applications", Tata Mc Graw Hill, New Delhi,8th Edition, 2014.

R2.S.Salivahanan and S.Arivazhagan,"Digital Circuits and Design", Oxford University Press,5th Edition, 2018.

R3. Morris Mano.M.Michael D Ciletti,"Digital Design", Pearson Education, 4th Edition, 2008.

R4: John M.Yarbrough, "Digital Logic Application & Design", Thomson, 2010.

R5: Donald D.Givone,"Digital Principles and Design",TMH, 2003.

Web References:

1. https://nptel.ac.in/courses/117105080/
2. https://nptel.ac.in/courses/117106086/

Course Code: 23EVT302		Course Title: Analog Electronics	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on design and analysis of amplifier and oscillator circuitsusing BJTs and MOSFETs.

Module I **22 Hours**

BJTs: Biasing -Load line, operating point, biasing techniques, stability, Analysis of CE amplifier - Gainand frequency response – Small signal model –Estimation of gain, input and output resistance, Basic operation of CB, CC amplifier.

Feedback Amplifiers: Advantages of negative feedback – Voltage / Current, Series, Shunt feedbackAmplifiers; Positive feedback–Condition for oscillations, Phase shift – Wien bridge, Hartley, Colpitt's and Crystal oscillators.

Module II **23Hours**

MOSFET: Analysis of CS amplifier - Load line, operating point, small signal model– Estimation of gain,input and output resistance, Basic operation of CG amplifier and Source follower. MOS Differential amplifier – Principle of operation, calculation of common mode gain and differential gain, slew rate, CMRR and ICMR. - Cascode and Cascade Amplifier.

Power Amplifiers: Class A, B, AB- push-pull Complementary amplifier, C – Calculation of power efficiency and linearity issues.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Construct amplifier circuits using BJT and derive equations for gain, inputand output resistance.	Apply
CO 2: Construct oscillator circuits using BJT.	Apply
CO 3: Develop the MOSFET amplifier circuits and derive equations for gain, input and output resistance.	Apply
CO 4: Develop MOSFET power amplifiers and compare the power efficiency.	Apply
CO5: Select suitable amplifiers and oscillators based on the application, and present a report or seminar.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	-	3	-	-	-	-	-	-	1	1	-	-	1	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Adel S.Sedra, Kenneth C.Smith & Arun N.Chandorkar, “Microelectronic Circuits: Theory and Applications”, 7/e, Oxford University Press, New York, 2014.

T2. Donald A Neamen, “Microelectronics: Circuit Analysis and Design”, Edition 4, 2010.

Reference Book(s):

R1. P.Malvino, D.J.Bates, “Electronic Principles”, 7/e, Tata McGraw-Hill, 2017.

R2. R.L.Boylestadad and L.Nashelsky “Electronic Devices and Circuit Theory”, 11/e, Pearson Education, 2015.

Web References:

1. https://archive.nptel.ac.in/courses/108/105/108105158/

Course Code: 23EVI301		Course Title: Data Structures and Algorithms using Python	
Course Category: Multi-Disciplinary		Course Level: Intermediate	
L:T:P(Hours/Week) 2:0 : 2	Credits:3	Total Contact Hours:60	Max Marks:100

Course Objectives:

The course is intended to teach students to create and implement required linear and non-linear data structures for given applications. Also, the course is intended to provide ability to apply suitablesearching and sorting techniques to solve a given problem.

Module I **16 Hours**

Linear Data structure: Data Structures types - Abstract Data Types - List ADT: Array and Linked List Implementation - Stack ADT: Implementation of Stack – Queue ADT: Implementation of Queue.

Non-Linear Data Structure: Tree **-** Preliminaries - Binary tree - Tree traversal - Applications - Binary search tree.

Data Structures for Switching Functions: Binary Decision trees - Introduction to Ordered Binary decision trees (OBDD) - Boolean functions - Boolean algebra - Switching functions - Subfunctions and Shannon's expansion - Visual representation.

Module II **14 Hours**

Non Linear Data Structure: Graph Representation - Graph Traversals: Depth first and Breadthfirst traversal - Topological sort - Shortest path algorithms: Weighted Graphs - Dijkstra's algorithms - Minimum Spanning Tree: Prim's and Kruskal's algorithms.

Searching: Linear Search – Binary Search. **Sorting:** Bubble sort- Insertion Sort - Merge sort –Quick Sort.

List of experiments **30Hours**

1. Implementation of stack and queue
2. Implementation of linked list
3. Applications of stack
   a. Infix to post fix conversion
   b. Evaluation of postfix expression
4. Implementation of Binary search tree
5. Implementation of searching - linear, Binary
6. Implementation of sorting technologies, Merge and Quick sort

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Identify the appropriate data structures as per the specified problem definition using Python.	Apply
CO 2: Develop Tree data structure for the given Scenario.	Apply
CO 3: Develop graph data structure for the given application.	Apply
CO 4: Demonstrate searching and sorting techniques for any given problem with an oral presentation.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	-	-	-	-	-	-	-	-	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	-	-
CO4	-	2	-	-	-	-	-	-	2	2	-	-	-	-

High-3; Medium-2; Low-1

Text Book(s):

T1.Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, “Data Structures andAlgorithms in Python”, Wiley, July 2021.

T2.Christoph Meinel and Thorsten Theobald, “Algorithms and Data Structures in VLSI Design”,Springer 1998.

Reference Book(s):

R1. John Canning, Alan Broder, Robert Lafore, “Data Structures & Algorithms in Python”, Addison-Wesley Professional, October 2022.

R2. Dr. Basant Agarwal, “Hands-On Data Structures and Algorithms with Python”, Packt Publishing, July 2022.

R3. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C”, 2nd Edition, PearsonEducation Asia, New Delhi, 2011.

Web References:

1. https://www.udemy.com/course/data-structures-and-algorithms-bootcamp-in-python/
2. https://www.udemy.com/course/data-structures-using-python/
3. https://onlinecourses.nptel.ac.in/noc24_cs78/

Course Code: 23EVL301		Course Title: Digital IC Laboratory	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)0:0:3	Credits:1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to explain the design principles of combinational and sequential circuits.

List of Experiments:

1. Design of full adder / full subtractor using logic gates.
2. Design of encoder / decoder using logic gates.
3. Design 2:1 multiplexer using universal 7400 IC / 7402 IC.
4. Design of basic flip-flops.
5. Design 4-bit SISO shift register and implement the same using 7474 IC.
6. Design 4-bit SIPO shift register and implement the same using 7476 IC.
7. Realize state table, state diagram, circuit diagram of 3-bit synchronous counter, andimplement the same using 7474 IC.
8. Realize state table, state diagram, circuit diagram of 3-bit synchronous counter, andimplement the same using 7476 IC.
9. Realize state table, state diagram, circuit diagram of mod-5 counter, and implement thesame using 7474 IC.
10. Realize state table, state diagram, circuit diagram of mod-5 counter, and implement thesame using 7476 IC.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design combinational circuits using basic gates	Apply
CO2: Build synchronous sequential circuits using Flip Flops.	Apply
CO3: Design shift registers and counters using Flip Flops.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	2	-	-	1	1	1
CO2	3	-	-	-	-	-	-	-	2	-	-	1	1	1
CO3	3	-	-	-	-	-	-	-	2	-	-	1	1	1

High-3; Medium-2;Low-1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering andTechnology

Course Code: 23EVL302		Course Title: Analog Electronics Laboratory	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)0:0:3	Credits:1.5	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on design and analysis of simple circuits with SPICE simulations using BJTs and MOSFETs.

List of Experiments:45 Hours

1. Introduction to SPICE simulations and hardware workbench.
2. Design and analysis of Single Stage Amplifier for the given specification using BJT.
3. Design and analysis of Multistage Amplifier for the given specification using BJT.
4. Design and analysis of Class B Amplifier for the given specification using BJT.
5. Design and analysis of Class AB Amplifier for the given specification using BJT.
6. Design and analysis of MOS Single Stage Amplifier for the given specification.
7. Design and analysis of MOS Differential Amplifier for the given specification.
8. Design and analysis of Series Shunt Feedback Amplifier for the given specification.
9. Design of RC Phase Shift Oscillators for the given specification.
10. Design of Colpitts oscillator and Hartley oscillator for the given specification.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Analyze amplifier and oscillator circuits using BJTs for the given specification	Analyze
CO2: Analyze amplifier circuits using MOSFETs for the given specification	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	2	-	-	1	1	1
CO2	-	3	-	-	-	-	-	-	2	-	-	1	1	1

High-3; Medium-2;Low-1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering andTechnology

Course Code: 23ESL301		Course Title: Professional Skills 2: Problem solvingskills & Logical Thinking 2 (Common to all B.E/B.Tech Programmes)	
Course Category: SEC		Course Level: Intermediate	
L:T:P(Hours/Week)0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objectives:

The course is intended to enhance the students' numerical, analytical and logical reasoning ability. Also, course focus to make learners prepare for various public andprivate sector exams and placement drives.

Module I **20 Hours**

Quantitative Ability

Time and work –Pipes and cisterns- - Time Speed Distance-Problems on Trains-Boatsand Streams- Permutation and Combination-Probability, Mensuration- Heights and distance- Logarithms- Clocks and Calendars – Data Sufficiency

Module II **10 Hours**

Reasoning Ability

Number & Alpha series- Odd man out-Coding and Decoding-Syllogisms- - Problems onCubes and Dices- Logical Venn diagram -Visual Reasoning-Element & logical series.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Enhance their problem solving skills & Logical thinking Skills	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	3	1	1

High-3; Medium-2; Low-1

Textbook(s):

T1:Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt.
Ltd, New Delhi, 2018.
T2:Dr. R. S. Aggarwal. “A Modern Approach to Logical Reasoning”, Sultan Chand & Sons Pvt. Ltd,New Delhi, 2018

Reference Book(s):

R1: R. V. Praveen. “Quantitative Aptitude and Reasoning” 2nd Revised Edition, Prentice-Hall of IndiaPvt.Ltd, 2013
R2:Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, McGraw Hill Publications, 5thEdition, 2020
R3:Arun Sharma. “Logical Reasoning for Common Aptitude Test”, McGraw Hill Publications, 6thEdition, 2021.

Web References:

1. https://www.indiabix.com/aptitude/questions-and-answers/
2. https://www.geeksforgeeks.org/aptitude-questions-and-answers/

Course Code: 23VAT301	Course Title: Universal Human Values 2: Understanding Harmony		
Course Category: VAC		Course Level: Intermediate	
L:T:P (Hours/Week) 2:1: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives

The course is intended to:

1. Development of a holistic perspective based on self-exploration about themselves (human being), family,society and nature/existence.
2. Strengthening of self-reflection
3. Understanding (or developing clarity) of the harmony in the human being, family, society andnature/existence
4. Development of commitment and courage to act
5. Development of a holistic perspective based on self-exploration about themselves (human being), family,society and nature/existence.

Unit I Introduction to Value Education 9 Hours

Need for the Value Education; Self -exploration as the process for value education; Continuous Happiness andProsperity: A look at basic Human Aspirations; Right understanding: Relationship and Physical Facilities; Happiness and Prosperity: current scenario; Method to fulfill the Basic human aspirations

Unit II Harmony in Human Being 9 Hours

Human being as a co-existence of self (‘I’) and the material ‘Body’; needs of Self ('I') and 'Body'; The Body as aninstrument of ‘I’; Harmony in the self (‘I’); Harmony of the self (‘I’) with body; Sanyam and Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail. Programs to ensure Sanyam and Swasthya.

Unit III Harmony in the Family and Society 9 Hours

Harmony in the Family the basic unit of human interaction; Values in human to human relationship; Trust as the foundational values of relationship; Respect as the right evaluation; Understanding harmony in the society (society being an extension of family); Vision for the universal human order.

Unit IV Harmony in the Nature 9 Hours

Understanding the harmony in the Nature Interconnectedness, self-regulation and mutual fulfillment among the four orders of nature; Existence as Co-existence at all levels; Holistic perception of harmony in existence.

Unit V Harmony on Professional Ethics 9 Hours

Natural acceptance of human values; Definitiveness of Ethical Human Conduct; Basic for Humanistic Education,Humanistic Constitution and Humanistic Universal Order; Competence in professional ethics; Case study: holistic technologies, management models and production systems; Strategy for transition towards value-based life and profession.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Reflect on values, aspiration, relationships and hence identify strengths and weaknesses.	Responding
CO2: Appraise physical, mental and social wellbeing of self and practice techniques to promotewellbeing.	Responding
CO3: Value human relationships in family and society and maintain harmonious relationships.	Valuing
CO4: Respect nature and its existence for survival and sustainable of all life forms and hencepractice conservation of nature	Valuing
CO5: Appreciate ethical behavior as a result of value system in personal and professionalsituations	Receiving

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	1	2	2	-	-	2	-	-
CO2	-	-	-	-	-	1	2	2	2	1	-	2	-	-
CO3	-	-	-	-	-	2	2	2	2	1	-	2	-	-
CO4	-	-	-	-	-	2	2	2	2	-	-	2	-	-
CO5	-	-	-	-	-	1	2	2	2	-	-	2	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, NewDelhi, 2010.

Reference Book(s):

R1. Jeevan Vidya: E k Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.

R2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.

R3. The story of stuff, Annie Leonard, Free Press, New York 2010.

Web References:

1. https://aktu.ac.in/hvpe/ResourceVideo.aspx
2. http://hvpenotes.blogspot.com/
3. https://nptel.ac.in/courses/109/104/109104068/

SEMESTER IV

Course Code: 23MAI401		Course Title: Probability Theory and Statistics	
Course Category: Minor		Course Level: Intermediate	
L:T:P(Hours/Week)3:0 :2	Credits: 4	Total Contact Hours:75	Max Marks:100

Course Objectives:

This course aims at providing the student to acquire the knowledge on random variables and probability distributions. They gain knowledge regarding hypothesis testing for data.

Module I **23 Hours**

Probability and Random Variables: Axioms of Probability- Conditional Probability- Total Probability -Baye's Theorem- Random Variables- Probability Mass Function- Probability Density Functions-Properties - Moments- Moment generating functions and their properties. **Standard Distributions:** Discrete Distributions - Binomial- Poisson- Properties, Moment generating functions. Continuous Distributions - Uniform –Exponential- Normal Distributions and their properties. **Two Dimensional Random Variables**: Joint distributions – Marginal and conditional distributions –Covariance – Correlation and linear regression using least square method – Transformation of random variables.

Module II **22 Hours**

Test of Hypotheses: Sampling distributions, Estimation of parameters, Statistical hypothesis, Large sample test based on Normal distribution for single mean and difference of means, Tests based on t, Chi-square and F distributions for mean, variance and proportion, Contingency table (test for independent), Goodness of fit. **Design of Experiments:** Analysis of Variance (ANOVA)- One Way Classification– Completely Randomized Design(CRD) – Two-way Classification – Randomized Block Design (RBD) –Latin square.

List of Experiments: **30 Hours**

1. R programing for basic arithmetic operators.
2. Probability distributions (Discrete & Continuous) using R Programming.
3. Calculate correlation coefficient using R Programming.
4. Small sample test using R Programming.
5. Large sample test using R Programming.
6. One way, two-way Classification using R Programming.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply standard distributions and the concepts of random variables, to solve real-world problems.	Apply
CO2: Use the concept of probability distributions to solve real life problems.	Apply
CO3: Using correlation coefficient and discusses the relationship between two variables.	Apply
CO4: Apply variance to analyze the samples.	Apply
CO5: Demonstrate the concepts of standard distributions and testing of hypothesis using modern tools (For Laboratory component only)	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High-3; Medium-2; Low-1

Text Book(s):

T1. Veerajan T, “Probability, Statistics and Random process”, 3rd Edition, Tata McGraw-Hill, NewDelhi, 2017.
T2. Dr.J.Ravichandran, “Probability and Statistics for Engineers”, 1stEdition, Wiley India Pvt. Ltd.,2010.

Reference Book(s):

R1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, “Probability and Statistics for Engineers andScientists”, 9th Edition Pearson Education, Asia, 2013.
R2. M.R. Spiegel, J. Schiller and R.A. Srinivasan, “Schaum's Outlines Probability and Statistics”, 4th Edition Tata McGraw Hill edition, 2012.
R3. Morris DeGroot, Mark Schervish, “Probability and Statistics”, Pearson Educational Ltd,

Web References:

1 https://archive.nptel.ac.in/courses/111/105/111105090/
2. https://archive.nptel.ac.in/courses/111/105/111105041/

Course Code: 23EVT401		Course Title: Linear Integrated Circuits	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on OPAMP internal structure, frequency characteristics and utilize the same to develop application circuits. Also the course imparts a depth knowledge on PLL and Timer circuit design.

Module I **22 Hours**

Operational amplifier: Internal Structure, Characteristics of ideal OPAMP, IC 741 packages, open- loop configurations, non-ideal effects in op-amp, Frequency response of an op-amp. OPAMP with negative feedback: Voltage Series, Voltage Shunt feedback configurations. **Applications of OPAMP:** Linear OPAMP Applications - Summing amplifier, subtractor, integrator, differentiator, difference amplifier, instrumentation amplifier, voltage-to-current converter, current-to- voltage converter – OPAMP applications using Diodes: Logarithmic amplifiers, Rectifiers, Peak detectors, and as Voltage regulators.

Module II **23 Hours**

Comparators and Waveform Generators: Comparator and its applications, Schmitt trigger, Free- running, One-shot Multivibrators, Barkhausen Criterion; Waveform generators- Sine, Square, Triangular, and Saw-tooth. **Active filters**: Classification of filters, frequency and impedance scaling, First and second order Low-pass and High pass filters, Band-pass filter, Notch filter. **PLL and Timers:** PLL-Phase detector, comparator, VCO, Applications of PLL; 555 timer IC- Astable and Monostable operations and applications.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO 1: Make use of the internal structure, characteristics, and frequency response of operational amplifiers to evaluate their suitability for various applications.	Apply
CO 2: Identify the feedback configurations in operational amplifier develop application circuits.	Apply
CO 3: Utilize OPAMPs to develop comparators, and waveform generators.	Apply
CO 4: Apply active filters, PLLs, and timers to design and implement circuits for signal processing and control applications.	Apply
CO 5: Select suitable amplifiers and oscillators based on the application, and present a report or seminar (only for Assignment)	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO5	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High-3; Medium-2;Low-1

Text Book(s):

T1. J.D.Roy Choudhury,"Linear integrated Circuits",2017,5th Edition, New-Age International Publishers, Chennai.

T2. K. R. Botkar, "Integrated Circuits" 10th Edition, Kp, 2010.

Reference Book(s):

R1. Ramakant A.Gayakwad,"Op-Amps and Linear Integrated Circuits",2015,4th Edition, Pearson Education, Bangalore.

R2. Robert F.Coughlin and Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits",2015, 6th Edition, Pearson Education, Bangalore.

Web References:

1. https://onlinecourses.nptel.ac.in/noc24_ee73/preview
2. https://archive.nptel.ac.in/courses/108/108/108108111/

Course Code: 23EVT402		Course Title: Signals and Systems	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 3:1:0	Credits:4	Total Contact Hours: 60	Max Marks:100

Course Objectives:

The course is intended to classify various continuous-time, discrete-time signals and systems. Also, the course imparts the spectral characteristics of continuous-time signals and systems using Fourier and Laplace transforms, and discrete time signals and systems using Z transform.

Module I **23 + 5 Hours**

Classification of Signals: Continuous Time (CT) and Discrete Time (DT) signals - Deterministic and Random signals, Periodic and Aperiodic signals - Even and Odd signals - Energy and Power Signals -Unit step, Ramp, and Impulse signals - Operation on signals: Time shifting, scaling and folding. **Sampling and Reconstruction:** Sampling of continuous time signals - Frequency domain representation of samples - Sampling theorem - Effects of under sampling - Aliasing - Reconstruction of continuous time signals from samples. **Classification of Systems:** Continuous time systems - Discrete time systems - Linear system - Time invariant system - causal system - BIBO stable system - system with and without memory – LTI system.

Module II **22+ 10 Hours**

Analysis of Continuous Time Signals and Systems: Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and Properties - Impulse response - Convolution integrals - Differential Equation- Fourier and Laplace transforms in analysis of CT systems - Systems connected in series / parallel. **Analysis of Discrete Time Signals and Systems:** Baseband signal Sampling–Fourier Transform of discrete time signals (DTFT) - Properties of DTFT - Z Transform & Properties - Impulse response– Difference Equations - Convolution sum- Discrete Fourier Transform and Z Transform analysis of Recursive & Non - Recursive systems-DT systems connected in series and parallel.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply mathematical operations to classify signals based on their properties.	Apply
CO2: Apply the concept of Sampling and Reconstruction on continuous Time signals	Apply
CO3: Apply mathematical operations to classify systems based on their properties.	Apply
CO4: Analyze continuous-time signals and systems using Fourier Series, Fourier Transform, and Laplace Transform.	Analyze
CO 5: Analyze discrete-time signals and systems using DTFT and Z – Transform.	Analyze
CO 6: Identify the characteristics of EEG signals and arrive at suitable specifications to design an EEG amplifier also give suitable ESD values for human body model. (only for Assignment)	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO5	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO6	-	-	3	-	2	-	-	2	1	1	1	2	1	2

High-3; Medium-2;Low-1

Text Book(s):

T1. Allan V. Oppenheim, S. Wilsky and S.H.Nawab "Signals and System", Pearson education, 2007.

T2. Simon Haykins and Barry Van Veen,"Signals and Systems",John Wiley & Sons,2004.

Reference Book(s):

R1. HPHsu,Rakesh Ranjan,"Signals and Systems",Schaum's Outlines,Tata McGraw Hill,IndianReprint, 2007.

R2. Edward W Kamen, Bonnie S Heck, "Fundamentals of Signals and Systems Using the Weband MATLAB", Pearson Education, 2007.

R3. Vinay K Ingle, John G Proakis, "Digital Signal Processing using MATLAB", Cengage Learning, 3rd edition, 2011.

Web References:

1. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011
2.http://www.ws.binghamton.edu/fowler/Fowler%20Personal%20Page/EECE301%20-%20Flipped.htm
3. https://nptel.ac.in/courses/117/104/117104074/

Course Code: 23EVI401		Course Title: Fundamentals of VLSI	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 3:0:2	Credits:4	Total Contact Hours: 75	Max Marks:100

Course Objectives:

The course is intended to explain the design of various blocks of digital and analog systems and verify their functionality at pre-layout and at Layout level. Additionally, the course discusses the technologies involved in chip fabrication and packaging.

Module I **22 Hours**

System and Architectural Design: Defining a system specification, performance analysis, cost analysis, identifying various functional blocks/modules; categorizing them in terms of digital, analog, RF and mixed signal blocks. **Functional verification, logic design:** Verifying the functionality of blocks, behavioural description, logic minimization, synthesis, verification and testing; PVT simulations.

Module II **23 Hours**

Circuit Optimization and Physical Design: Optimization of synthesized blocks for various performance metric, Introduction to placement and routing, Layout vs Schematic (LVS) verification, Design for Manufacturability. **Tape Out:** Post layout simulations, Process Voltage Testing, Process Design Kit, Design Rule Check, GDSII. **Fabrication and Packaging:** CMOS process flow, dicing, various types of packaging. **Process followed in industry:** Roles and objectives of various streams within Semiconductor industry, Industry Terminologies.

List of Experiments **30 Hours**

1. Arrive at the system specifications for a given real-time case.
2. For a given problem statement, arrive at the reduced logic circuit. Verify the functionality using SPICE simulations at different PVT corners.
3. Design a CMOS inverter and verify its DC characteristics through SPICE simulations. Estimate power dissipation, area, and processing delay. Understand rise and fall times through simulations.
4. Realize NAND and NOR gates in CMOS logic. Verify truth tables through SPICE simulations.
5. Design the physical layout of a CMOS inverter. Perform DRC clean and LVS.
6. Perform post-layout simulations of the CMOS inverter. Comparative study of layout and schematic parameters.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Design the simple digital and analog systems for the given specification	Apply
CO 2: Utilize circuit optimization in physical design of simple digital and analog systems	Apply
CO 3: Identify the technologies involved in chip fabrication, packaging and process integration in semiconductor industry	Apply
CO 4: Examine and report the analog and digital IC design process using SPICE simulations. (Lab Component only)	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	1	-	-	2	1	1	2	1	1	1

High-3; Medium-2; Low-1

Text Book(s):

T1.Sneh Saurabh, “Introduction to VLSI Design flow”, Cambridge University Press.

Reference Book(s):

R1.M.Morris Mano and Michel.D.Ciletti, “Digital Design with an introduction to HDL,VHDL and Verilog”, 6th edition Pearson education.

Web References:

1. https://nptel.ac.in/courses/117106092

Course Code: 23EVT403		Course Title: Microprocessors and Microcontrollers	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)3:0:0	Credits: 3	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on microprocessor and microcontroller architecture, develop programs for on-chip peripherals, and design systems using interfacing.

Module I **22 Hours**

Microprocessor and Microcontroller Architecture: Introduction to Microprocessor and Microcontroller– Evolution – Von Neumann and Harvard architecture - Architecture of 8085 & 8051 - CISC Vs RISC. **PIC Microcontroller and Progamming:** PIC18FX Pin connection - File register - Data type and Time delay in C - Logical operation –Data conversion - Data sterilization - Program ROM Allocation - Data RAM allocation. **On-Chip Peripherals of PIC Microcontroller:** I/O Ports-Timer0/counter – UART - Interrupts - ADC - DAC - SPI - I2C.

Module II **23 Hours**

Architecture of ARM: ARM7 processor fundamentals – Registers - Pipelining – Exception and Interrupt handling - Memory System - **on-chip peripherals of LPC2148**: GPIO, Timers, PWM, Serial ports–RTC-ADC- Introduction to ARM cortex Mx - Processors core overview - Programmers model. **System Design and Application:** LED and Switch interfacing-LCD Interfacing – Keyboard Interfacing- Relay interfacing – Sensor Interfacing - Stepper Motor Interfacing - PWM Module – DC Motor Interfacing.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Apply microprocessor and microcontroller architecture principles to design systems.	Apply
CO2: Develop application programs to design PIC18FX microcontroller based systems using on-chip peripherals.	Apply
CO3: Design systems and develop a program for on-chip peripherals in ARM7 and LPC2148.	Apply
CO4: Develop application systems using ARM7 and LPC2148 using interfaces.	Apply
CO5: Design and develop a program for real world application systems using microprocessor and microcontroller (only for Assignment)	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	-	3	-	-	-	-	-	-	-	-	-	1	1
CO4	-	-	3	-	1	-	1	-	1	1	-	1	-	-

High-3; Medium-2;Low-1

Text Book(s):

T1. R.S.Gaonkar,"Microprocessor Architecture, Programming and Applications with the 8085", 5th Edition, Prentice Hall, 2002.

T2. Muhammad ALI Mazidi, RolinD.Mckinlay, Danny Causery,"PIC Microcontroller and Embedded systems using assembly and C PIC18", Pearson international edition, 2008.

Reference Book(s):

R1. A.K Ray , K.M.Bhurchandi ,"Advanced Microprocessors and Peripherals" 3rd Edition McGraw Hill Education 2012

R2. Steve Furber, "ARM System-on-Chip Architecture" Pearson Education Limited, 2012

R3. Krishna Kant, "Microprocessor and Microcontroller Architecture, Programming and System Design using 8085, 8086, 8051 and 8096", PHI, 2011.

Web References:

1.https://www.nxp.com/docs/en/user-guide/UM10139.pdf

2.http://www.microchip.com/design-centers/microcontrollers

3.https://electrosome.com/category/tutorials/pic-microcontroller/hi-tech-c/

4.https://ww1.microchip.com/downloads/en/devicedoc/39582b.pdf

Course Code: 23EVL401	Course Title: Microprocessors and Microcontrollers Laboratory		
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on developing programs to perform arithmetic operations with 8085 Microprocessor, application development with interfacing techniques in PIC16Fxx/LPC2148**.**

List of Experiments **45 Hours**

8085 Microprocssor

1. Arithmetic Operation-Addition & Subtraction

PIC16FXX/18FXX Microcontroller

2. LED and switch interfacing
3. Lamp control using Timer/Counter
4. Transmission and Reception of a byte using on chip serial port
5. Read the temperature sensor value using ADC and display it in LCD

LPC2148 Microcontroller

6. Program to read switch status and displayed in LEDs.
7. Waveform generation using 10 Bit DAC
8. Controlling PWM period with analogue input (POT)
9. Transmission from kit and reception from PC using Serial Port (UART)
10. IoT based Temperature/Moisture monitoring system.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Develop assembly language program to perform addition and subtraction using the 8085 microprocessors.	Apply
CO2: Experiment with PIC16FXX/18FXX Microcontroller and its interfacing techniques.	Apply
CO3: Experiment with LPC2148 Microcontroller and its interfacing techniques.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	1	1
CO2	3	-	-	-	1	-	-	-	1	1	-	1	1	1
CO3	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High-3; Medium-2;Low-1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering and Technology

Course Code: 23EVL402		Course Title: Linear Integrated Circuits Laboratory	
Course Category: Major		Course Level: Intermediate	
L:T:P(Hours/Week)0:0 :4	Credits:2	Total Contact Hours:60	Max Marks:100

Course Objectives:

The course is intended to incorporate knowledge on design and analysis of simple linear integrated circuits using OP-AMP ICs.

List of Experiments: **60 Hours**

1. Design of Inverting, Non-Inverting amplifiers, and Voltage follower.
2. Perform mathematical operations using operational amplifier.
3. Design of Instrumentation amplifier.
4. Design and testing of Precision Rectifier.
5. Design of Comparator and Schmitt trigger circuits.
6. Design of Square wave generator for a specified frequency and duty cycle, using operational amplifier IC741.
7. Design of Triangular wave generator from Square wave generator.
8. Design of a Sinusoidal oscillator for specified frequency – Wien-bridge and RC phase shift oscillators using IC741.
9. Design of Audio Q Multiplier using IC741.
10. Design and testing of Active filters - LPF and HPF for specified frequency.
11. Design of Astable and Monostable Multivibrators using IC555.
12. Design of A/D and D/A converters.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design simple analog circuits to perform mathematical operations, rectification and analog comparison.	Apply
CO 2: Design waveform generators, multivibrators, A/D and D/A converters.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	1	1
CO2	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High-3; Medium-2;Low-1

Reference Book:

R1.Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering and Technology.

Course Code: 23ESL401		**Course Title Professional Skills 3 : Professional Development and Etiquette (Common to all B.E/B.Tech Programmes)**	
Course Category: SEC		**Course Level: Intermediate**	
L:T:P(Hours/Week)0: 0: 2	**Credits: 1**	**Total Contact Hours:30**	**Max Marks:100**

Course Objectives:

The course is intended to cultivate students' appropriate etiquette across various personal and professional contexts, fostering professionalism and effective communication.

Module I **15 Hours**

Emotional Intelligence

Intrapersonal Skill: Goal Setting- Self-management- Emotional Intelligence: Understanding & Developing EI for Effective Communication and Relationships –Enhancing Social Skills

Professional Development

Introduction to Professional Development - Career State Assessment - Set Career Goals- Stay on Industry Trends - Self & Lifelong learning – Creativity - Problem Solving Skills - Strong Fundamentals – Using/ Creating Opportunities – Work & Life Balancing - Revisiting Goals

Teamness and Interpersonal skills

Paraphrasing: Techniques for Active Listening -Paraphrasing as a Tool for Effective Understanding and Communication – Collaboration and Team Building: Building Trust and Rapport - Self-paced learning.

Module II **15 Hours**

Effective Communication

Effective Verbal Communication - Assertive Communication - Elements of Effective Communication - Barriers to Effective Communication - Persuasion Skills - Effective Presentation: Oral and visual presentation – Drafting formal reports.

Professional Etiquette

Introduction - Types of professional Etiquette- Personal Grooming: Importance of Personal Grooming in Professional Settings- Dress Codes and Professional Appearance Guidelines- Body language - Social – Email – Telephonic – Dining – Classroom -

Activities:

- Emotional Intelligence: Scenario based role play, Debate
- Paraphrasing: Listening, Reading
- Effective Presentation:
  - Oral Presentation: Self-Introduction, JAM, Extempore speech
  - Visual presentation: Email Writing, Power Point Presentation, Vlog
- Professional Etiquette: Demonstrate required Professional Etiquette in all the above activities.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO1: Communicate effectively and exhibit Professional etiquettes in various social forums.	**Apply**

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	2	2	3	-	1	1	1

High-3; Medium-2; Low-1

Textbook(s):

T1. Sabina Pillai, Agna Fernandez, “Soft Skills & Employability Skills”, Cambridge University Press2018

T2. Peggy Post &Peter Post, “The Etiquette Advantage in Business: Personal Skills for Professional Success”, 2nd edition (May 3, 2005), William Morrow.

Reference Book(s):

R1. Ashraf Rizvi, "Effective Technical Communication" 2nd Edition, McGraw-Hill India, 2018

R2. Maithry Shinde, Jyotsna Sreenath, “Life Skills & Personality Development”, Cambridge University Press 2022

Web References:

1. https://www.indeed.com/career-advice/career-development/etiquette-at-work
2. https://www.skillsyouneed.com/interpersonal-skills.html

SEMESTER V

Course Code: 23EVT501		Course Title: FPGA Based System Design	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on FPGA Architecture, develop logic circuits, use HDL models and implement complex digital sub-systems on FPGA.

Module I **22 Hours**

Overview of FPGA Architectures and Technologies: FPGA Architectural options, granularity of function and wiring resources, coarse vs. fine-grained architectures. ASIC vs FPGA, Examples of usecases where ASIC is used and where FPGA is used –Introduction to pi layer protocols. **Logic and I/O Blocks:** Logic cells, timing models, power dissipation. I/O blocks **-** Input and output cell characteristics, clock input, timing, and power dissipation. **Programming Technologies**-Chip I/O- Programmable Logic Blocks- Fabric and Architecture of FPGA. **HDL Fundamentals and Arithmetic circuit design:** Verilog Behavioral, Data Flow and Structural Modeling, Useful Modeling Techniques. **Arithmetic Circuits:** Ripple carry adder, Carry look-ahead adder, Carry select adder, Parallel Multipliers.

Module II **23 Hours**

FSM and memory modelling: Synchronous and Asynchronous FIFO – Single port and Dual port ROM and RAM - FSM Verilog modeling of Sequence detector - Serial adder - Vending machine. **Synthesis and Timing Analysis:** Synthesis, Optimization of Speed: Introduction, Strategies for Timing Improvement; Optimization of Area, Optimization of power. **FPGA Applications:** Embedded system design using FPGAs, DSP using FPGAs, application case studies.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Compare the suitability of FPGA and ASIC architectures for different applications.	Apply
CO 2: Design HDL models for arithmetic circuits and perform FPGA implementation.	Apply
CO 3: Design and analyze FSM models for logic circuits and memories using Verilog HDL.	Apply
CO 4: Implement Embedded and DSP applications on FPGA.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book(s):

T1. Michael D Ciletti, Advanced Digital Design with the Verilog HDL, Prentice Hall, Second Edition, 2017.

Reference Book(s):

R1. Charles H Roth Jr, Lizy Kurian John and Byeong Kil Lee Digital Systems Design using Verilog, Cengage Learning, First Edition, 2016.
R2. Wayne Wolf, FPGA Based System Design, Prentices Hall Modern Semiconductor Design Series, 2011.
R3. Ming-Bo Lin, Digital Systems Design and Practice: Using Verilog HDL and FPGAs, Create Space Independent Publishing Platform, Second Edition, 2015.

Web References:

1. https://www.eeweb.com/beginners-guide-to-understanding-fpga-development/
2. https://learn.sparkfun.com/tutorials/programming-an-fpga/all

Course Code: 23EVT502		Course Title: Control Systems	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3:1:0	Credits:3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

This course introduces students to the fundamentals of Control Systems, covering open-loop and closed-loop systems, feedback, and system modeling techniques. Students will learn time and frequency domain analysis, and performance evaluation using Bode and Nyquist plots. The course also emphasizes state-space representation, stability analysis through eigenvalues, and concepts of controllability and observability.

Module I **23 Hours**

Control Systems and Mathematical modeling of systems: Basic components of a control system, Open-loop control system and closed loop control system – Transfer function, Effects of feedback on overall gain, Types of feedback control system, Linear and non-linear control systems – Transfer function - Mathematical modelling of electrical and mechanical systems, Block diagram reduction technique - Signal flow graph. **Time Domain Response and Characterization of Systems:** Transient response and steady state responses, Time domain specifications, Types of test inputs, Response of first order and second order systems, Steady state error, Static error coefficients, Generalized error coefficients. **Stability –** concept and definition, Poles, Zeros, Order and Type of systems; R-H criteria, Root locus analysis.

Module II **22 Hours**

Frequency Domain Response and State Space Analysis: Frequency response – Performance specifications in the frequency domain, Phase margin and gain margin, Bode plot, Polar plot and Nyquist plot, Stability analysis in frequency domain. **Dynamic system modeling in state space representation:** Diagonal canonical form, Jordan canonical form, Solutions of state equations of LTI system, Conversion from state space model to transfer function model and vice versa, Stability analysis in state spaces: Concept of eigenvalues and eigenvectors, State transition matrix using Cayley-Hamilton theorem, Controllability and observability.

Course Outcomes	**Cognitive Level**
At the end of this course, students will be able to:	
CO 1: Apply the basic concepts of control system to model systems and simplify representations using transfer functions, block diagrams, and signal flow graphs.	Apply
CO 2: Analyze the time-domain response, stability, and error characteristics of control systems using test inputs, root locus, and Routh-Hurwitz criteria.	Analyze
CO 3: Apply frequency response to determine performance specifications, construct plots, and analyze system stability.	Apply
CO 4: Analyze dynamic systems using state space representations, evaluate stability through eigenvalues and state transition matrices, and assess controllability and observability.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book(s):

T1. Norman S. Nise, Control Systems Engineering, 2019, 8th Edition, John Wiley & Sons, New Jersey, USA.
T2. S.Palani,"Control Systems Engineering", TMH, New Delhi, 2nd Edition,2020.

Reference Book(s):

R1. Farid Golnaraghi and Benjamin C. Kuo, Automatic Control Systems, 2017, 10th Edition, McGraw-Hill Education, India.
R2. I.J. Nagarth and M. Gopal, Control Systems Engineering, 2018, 6th Edition, New Age International Pvt. Ltd., New Delhi, India.
R3 Gene Franklin, J. Powell and Abbas Emami-Naeini, Feedback Control of Dynamic Systems, 2019, 8th Edition, Pearson Education, New Delhi, India.

Web References:

1. https://WWW.electrical 4u.com/mathematical-modelling -of-various-system/
2. https://nptel.ac.in/courses/108/106/108106098/
3.https://ocw.mit.edu/courses/mechanical-engineering/2-04a-systems-and-controls-spring-

Course Code: 23EVT503		Course Title: Digital Signal Processing	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours: 45	Max Marks: 100

Prerequisites: i) Complex variables and Transforms
ii) Signals and Systems

Course Objectives:

This course introduces students to key concepts in digital signal processing, including DFT, FFT, and filter design for both IIR and FIR systems. Students will learn analog and digital transformations, multi-rate processing techniques like DCT and Wavelet Transform to realise filter structures , equipping them with essential skills for practical applications.

Module I **23 Hours**

Discrete Fourier Transform, Properties and its applications: DFT – Properties - Linear filtering methods - Frequency analysis of signals using DFT – FFT Algorithm - Radix-2 FFT - Sparse FFT - Practical applications. **Design of Analog Filters:** Design techniques for analog filter - Butterworth and Chebyshev approximations – Frequency transformation, Properties - Constant group delay and zero phase filters. **Design of FIR filters:** FIR Filter Design: Design characteristics of FIR filters with linear-phase – Frequency response of linear phase FIR filters – Design of FIR filters using windowing techniques: Rectangular, Bartlett Hamming, Hanning, Blackmann, Kaiser - Phase delay, Group delay. **Digital transformation of IIR filters:** IIR filter design: Bilinear transformation, Impulse Invariance - Spectral transformation of Digital filters.

Module II **22 Hours**

Realization structures for Discrete-Time Systems: Direct, Cascade, Parallel, Lattice and Lattice - Ladder Structures: All pass filter - IIR tapped cascaded structure. Parallel all pass realization of IIR systems. **Multirate digital signal processing:** Introduction-Implementation of Sampling Rate Conversion: Polyphase Filter Structures - Interchange of Filters and Downsamplers / Upsamplers - Polyphase Structures for Decimation and Interpolation Filters - Structures for Rational Sampling Rate Conversion. Discrete Cosine Transform - Wavelet Transform.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply DFT, FFT algorithms, and analog filter design techniques to analyze signals and design Butterworth and Chebyshev filters.	Apply
CO 2: Analyze FIR and IIR filter characteristics, frequency response, phase/group delays, and evaluate design methods for digital filter transformations.	Analyze
CO 3: Apply realization techniques to implement discrete-time systems using direct, cascade, parallel, and lattice structures.	Apply

CO 4: Apply multirate signal processing techniques like polyphase and interpolation structures, DCT and wavelet transform to realize filter architecture.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO3	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book(s):

T1. John G. Proakis, Dimitris G Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, 2022, 5th Edition, Pearson, USA.
T2. S.K.Mitra, Digital Signal Processing, 2013, 4th edition, TMH, New Delhi, India.

Reference Book(s):

R1. A textbook of Digital Signal Processing, R.S.Kaler, M.Kulkarni, Umesh Gupta, 1st edition, 2019, Dream tech Press, Wiley, India.
R2. James McClellan, Ronal Schaeffer, Mark Yoder, Digital Signal Processing first, 2016, 2nd edition, Pearson, USA.
R3. Lizhe Tan, Jean Jiang, Digital Signal Processing: Fundamentals and applications, 3rd edition, 2018, Academic Press, USA.

Web References:

1. https://nptel.ac.in/courses/117102060
2. https://nptel.ac.in/courses/108/105/108105055/
3. https://ep.jhu.edu/courses/525627-digital-signal-processing/

Course Code: 23EVL501		Course Title: FPGA Based System Design Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on design of combinational, sequential circuits, logic controllers for real time systems, and implement the same on FPGA.

List of Experiments **45 Hours**

1. Design and Simulation of Adders (Half adder, Full adder, 4-bit/8-bit Ripple carry adder).
2. Design and Simulation of Flip-Flops. (S-R Flip-Flops, JK Flip-Flops, D Flip-Flops, T Flip-Flops).
3. Design & Verification of 4 bit Adder using System Verilog.
4. FPGA Implementation of Encoder/Decoder
5. FPGA Implementation of Multiplexer/De-Multiplexer
6. FPGA Implementation of 4-bit Synchronous Counter.
7. FPGA Implementation of 32-bit adder using Chipscope.
8. FPGA Implementation of 16:1 Multiplexer / 1:16 De-Multiplexer using Chipscope.

Finite State Machine (FSM) based experiments

9. Design Traffic Light Controller / Vending Machine Controller and perform FPGA implementation.
10. Design Elevator Controller / Sequence Detector and perform FPGA implementation.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design adders, flip-flops, and digital circuits using System Verilog and implement on FPGA.	Apply
CO2: Design digital controllers for real-time systems and implement on FPGA..	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	1	1
CO2	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High = 3, Medium = 2, Low = 1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering and Technology

Course Code: 23EVL502		Course Title: Digital Signal Processing Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 0:0 :3	Credits: 1.5	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

This course equips students with practical skills in digital signal processing (DSP), covering DFT, IDFT, and FFT algorithms, signal sampling and reconstruction, DTFT and real time signal analysis. Also It equips with FIR and IIR filter designs, decimation and interpolation processes.

List of Experiments **45 Hours**

1. Write a program to find DFT/IDFT of given DT signal.
2. Write a program to perform Sampling and Reconstruction of CT signals, DTFT analysis.
3. Write a program to perform FFT on a sequence using the decimation in time method.
4. Write a program to perform FFT on a sequence using the decimation in frequency method.
5. Write a program to perform Biomedical / Speech / Audio Signal Analysis.
6. Write a program to design an FIR filter using windowing technique.
7. Write a program to design an IIR filter using Butterworth / Chebyshev approximation.
8. Write a program to design an IIR filter using bilinear transformation/impulse invariant method.
9. Write a program to implement the Decimation Process.
10. Write a program to implement the Interpolation Process.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Build programs to compute transforms, perform signal processing, and analyze various real time signals**.**	Apply
CO 2: Build programs to design FIR & IIR filters, and implement decimation, interpolation processes.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	1	1
CO2	3	-	-	-	1	-	-	-	1	1	-	1	1	1

High = 3, Medium = 2, Low = 1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering andTechnology

Course Code: 23ESL501		Course Title: Professional Skills 4: Communication Skills and Interview Essentials (Common to all B.E/B.Tech Programmes)	
Course Category: SEC		Course Level: Higher	
L:T:P(Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours:30	Max Marks:100

Course Objectives:

The course is intended to equip students with the necessary skills to effectively communicate in various professional settings and excel in the interview process

Module I **15 Hours**

Resume Building & Portfolio Management

Importance of a Strong Resume - Resume Content Development & Core Components – Formatting and Design - Tailoring and Customization – Proofreading - Portfolio Content, design and Structure: Components & Efficient portfolios – Preparing and Maintaining documents for interview – maintaining repositories - Enhancing Personal Brand - Digital Tools and Platforms

Interview - Dress code, Body Language and Grooming

Dress Code Essentials - Body Language – Facial expression, eye contact, gesture, posture, touch behavior & space- Personal Grooming

Effective Communication

Communication in Diverse Contexts - Presentations – Individual and group presentations - Public Speaking - Visual Aids and Presentation Tools

Module II **15 Hours**

Group Discussion

Introduction & types of Group Discussion – Prerequisites of GD – Techniques and tips of GD - Role of GDs in various professional contexts – GD Etiquettes – Strategies to enhance GD – Mock GD.

Interview Skills

Purpose of an interview - Types of Interviews –Interview Techniques – Interview Etiquette - Planning and Preparation - Mock Interviews with Feedback - Post-Interview Etiquette and Follow-Up

Activities:

Building Portfolio: Resume Building, Updating LinkedIn, Maintaining Repositories.

Effective Presentation:

Oral Presentation: Impromptu speech, Mini Presentation, Picture Perception (Both Speaking and Writing)

Visual presentation: Power Point Presentation, Vlog

Group Discussion: General, Technical

Mock Interview: General, Technical

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Communicate effectively and exhibit required competency in various professional environments and demonstrate proficiency in interview process.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	1	3	3	-	1	-	-

High-3; Medium-2; Low-1

Textbook(s):

T1. Ashraf Rizvi, "Effective Technical Communication" 2nd Edition, McGraw-Hill India, 2018.

T2. Pease, Allan, and Barbara Pease. "The Definitive Book of Body Language." Bantam, 2006.

Reference Book(s):

R1. Cheryl Hamilton, “Communicating for Results: A Guide for Business and the Professions”, 11th edition (1 January 2017), Wadsworth Publishing Co Inc.

R2. Whitcomb, Susan Britton. Resume Magic: Trade Secrets of a Professional Resume Writer. JIST Works, 2010.

R3. Carnegie, D. (2009). The Quick and Easy Way to Effective Speaking. Pocket Books.

Web References:

1 https://www.linkedin.com/pulse/interview-etiquette-dos-donts-interviews-brian-vander-waal-fmy8e/

2 https://www.simplilearn.com/group-discussion-tips-article.

SEMESTER VI

Course Code: 23EVT601		Course Title: CMOS Analog IC Design	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on MOSFET modeling, and its relevance in design and analysis of single ended , differential and Operational amplifiers.

Module I **22 Hours**

Basics of MOSFET: Structure, Threshold voltage, IV characteristics, SPICE modeling, Large small signal behavior. **Second order effects of MOSFET:** Short channel effect, temperature, voltage dependence - MOSFET passive elements: Capacitors and Resistors. **Analog MOSFET Model:** Low frequency, High frequency Models, Temperature and Noise in MOSFET - **Analog MOS modeling:** Current mirror, current sources, self-biasing techniques, voltage dividers - **Basic MOS Amplifier:** Common source, Common drain and common gate- Small signal and large signal analysis of all basic MOS amplifier.

Module II **23 Hours**

Differential Amplifier: Small signal, Large signal behavior-ICMR-PSRP-double ended, single ended, Gain, gain bandwidth and complete Analysis-Source coupled, cascaded load, wide sources. **Operational Amplifier:** Basic CMOS Amplifier – Fully differential Op-Amp – Small and Large signal analysis of Op-Amp, ICMR, CMRP, PSRR, Differential gain, common mode gain, Gain bandwidth and input, output impedances. Bandgap reference and beta multiplier based voltage references –design and analysis.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply MOSFET principles to analyze characteristics, simulate behavior, and design circuit elements.	Apply
CO 2: Apply MOSFET models to analyze circuit behavior, design biasing techniques, and evaluate amplifier performance.	Apply
CO 3 : Construct differential amplifier and evaluate performance parameters like Gain, ICMR, and PSRR.	Apply
CO 4: Design and analyze CMOS operational amplifiers and voltage references .	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	-	3	-	-	-	-	-	-	-	-	-	-	2	2

High = 3, Medium = 2, Low = 1

Text Book(s):

T1. Phillip E. Allen and Douglas R.Holberg ,“CMOS Analog Circuit Design”, 2nd edition, 2002.

Reference Book(s):

R1. “Microelectronics” by Behzad Razavi, 2019
R2. “Microelectronics: An Integrated Approach” by Roger T.Howe and Charles G.Sodini, 2004

Web References:

1. https://archive.nptel.ac.in/courses/117/101/117101105/
2.https://www.academia.edu/27961808/CMOS_Analog_Circuit_Design_by_Allen_and_Holberg

Course Code: 23EVT602		Course Title: ASIC Design	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3:0:0	Credits:3	Total Contact Hours: 45	Max Marks: 100

Course Objectives:

This course aims to provide students with HDL coding, synthesize HDL constructs, understand RTL synthesis Flow, perform Static Timing Analysis for ASIC, provide detailed insight on physical design and its importance in design verification

Module I **22 Hours**

ASIC Design Methodology & Design Flow: Implementation Strategies for Digital ICs: Custom IC Design- Cell-based Design Methodology - Array based implementation approaches - Traditional and Physical Compiler based ASIC Flow. **Verilog HDL Coding Style for Synthesis:** HDL Coding style – Guidelines and Recommendation - FSM Coding Guideline and Coding Style for Synthesis. Datapath and Control Logic Design. **RTL Synthesis**: RTL synthesis Flow – Synthesis Design Environment & Constraints – Architecture of Logic Synthesizer - Technology Library Basics– Components of Technology Library –Synthesis Optimization- Technology independent and Technology dependent synthesis- Data path Synthesis – Low Power Synthesis - Formal Verification.

Module II **23 Hours**

Basic Timing Analysis: Timing Parameter Definition – Setup Timing Check- Hold Timing Check- Multicycle Paths- Half-Cycle Paths- False Paths. **Advanced Timing Analysis:** Clock skew optimization – On-Chip Variations- AOCV-Time Borrowing- Setup and Hold Violation Fixing. **Physical Design:** Detailed steps in Physical Design Flow- Guidelines for Floor plan, Placement, CTS and routing– ECO flow – Signal Integrity Issues. **Physical Design Verification:** Timing Sign-off, Physical Verification – Signoff DRC and LVS, ERC, IR Drop Analysis, Electro-Migration Analysis and ESD Analysis.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO1: Design data path and control logic models using HDL code and ASIC methodologies.	Apply
CO2: Identify techniques to perform technology independent and technology dependent synthesis for datapath elements.	Apply
CO 3: Utilize the various timing parameters and perform Static Timing Analysis for ASIC design	Apply
CO 4: Implement physical design methodologies, including floor planning, placement, CTS, routing, and verification.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	2

High = 3, Medium = 2, Low = 1

Text Book(s):

T1. Vaibbhav Taraate, ASIC Design and Synthesis RTL Design Using Verilog, Springer, First Edition, 2021, Singapore.

Reference Book(s):

R1. Khosrow Golshan, PHYSICAL DESIGN ESSENTIALS an ASIC Design Implementation Perspective, First Edition, 2010.
R2. Michael John Sebastian Smith, Application-Specific Integrated Circuits, First Edition, 2002.
R3. J. Bhasker and Rakesh Chadha, Static Timing Analysis for Nanometer Designs, Springer, First Edition, 2010, USA.

Web References:

1. www.vlsi.wpi.edu/cds/explanations/lvs.html
2. http://www.eng.auburn.edu/
3. http://www.geoffknagge.com/fyp/index.shtml#asic

Course code: 23EVT603	Course Title: Low Power IC Design		
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective: To equip students with a knowledge on implementing algorithmic level, circuit level and software level power optimization techniques to design low power digital systems.

Module 1 **22 Hours**

Power Dissipation and Optimization in CMOS circuits: Power Dissipation in CMOS: Understanding the sources of power dissipation in CMOS devices, including static and dynamic power. **Power Optimization Techniques:** Algorithmic -Usecases; Circuit-level techniques to reduce power consumption, such as gate sizing, voltage scaling, and power gating. **Low Power Design for Arithmetic Circuits:** Designing low-power adders and multipliers using techniques like carry-save adders and parallel prefix adders.

Module II **23 Hours**

Low Power Design and Implementation: Design of Low Power CMOS Circuits: Designing low-power memories, clock and interconnect structures, and advanced low-power techniques. **Power Estimation:** Using various techniques to estimate power consumption at different design levels. **Synthesis and Software Design for Low Power:** Optimizing synthesis tools for low power and designing low power software applications. Compiler optimization for low power.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply power optimization techniques, including gate sizing, voltage scaling, and power gating, to reduce power dissipation in CMOS circuits.	Apply
CO 2: Implement low-power strategies to design arithmetic circuits, such as adders and multipliers.	Apply
CO3: Design low power memory elements and estimate power at various design levels.	Apply
CO4: Utilize synthesis and software level optimization techniques to build low power CMOS circuits.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	2	2
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	2

High = 3, Medium = 2, Low = 1

Text Books

T1. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.
T2. DimitriosSoudris, ChirstianPignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2002.
T3. J.B.Kulo and J.H Lou, “Low voltage CMOS VLSI Circuits”, Wiley 1999.

Reference Books

R1. A.P.Chandrasekaran and R.W.Broadersen, “Low power digital CMOS design”, Kluwer,1995.
R2. AbdelatifBelaouar, Mohamed.I.Elmasry, “Low power digital VLSI design”, Kluwer, 1995.
R3. James B.Kulo, Shih-Chia Lin, “Low voltage SOI CMOS VLSI devices and Circuits”, John Wiley and sons, inc. 2001.

Web References

1. https://archive.nptel.ac.in/courses/106/105/106105034/
2. https://archive.nptel.ac.in/courses/108/105/108105118/

Course Code: 23EVL601		Course Title: CMOS Analog IC Design Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week)0: 0: 3	Credits: 1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on analog MOSEFET models, utilize same to build amplifiers, and perform gain and stability analysis using SPICE simulation.

List of Experiments **45 Hours**

1. Characterize NMOS and PMOS for a given specification.
2. Design a CS amplifier with resistive load for a given specification.
3. Analyze the parameters of diode connected CS amplifier with resistive load counterpart.
4. Construct a CS amplifier with current mirror load for a given specification. Analyse the impact of bias voltage across the load element on the gain and UGB.
5. Design a MOS differential amplifier with double ended output and analyze the parameters.
6. Design a single ended MOS differential amplifier for a given specification.
7. Analyze the gain and UGB in a MOS differential amplifier with diode connected load.
8. Design a single ended Operational amplifier for a given specification.
9. Analyze the performance of double ended Operational amplifier for a given specification.
10. Design a bandgap voltage reference and analyze the impact of power supply and temperature variations on the output.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Utilize analog MOSEFET models to design Common source and differential amplifiers	Apply
CO2: Design and analyze Operational amplifier and voltage reference circuits.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	2	2
CO2	3	-	-	-	1	-	-	-	1	1	-	1	2	2

High = 3, Medium = 2, Low = 1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering andTechnology

Course Code: 23EVL602		Course Title: ASIC Design Laboratory	
Course Category: Major		Course Level: Higher	
L:T:P(Hours/Week) 0: 0: 3	Credits: 1.5	Total Contact Hours: 45	Max Marks:100

Course Objectives:

The course is intended to impart knowledge on digital architecture design flow from RTL coding to Physical synthesis and verification.

List of Experiments **45 Hours**

1. Design a Digital architecture for given specification
2. Implement FSM guidelines to design a digital architecture.
3. Perform Logical Synthesis of Digital architecture
4. Analyze the impact of technology dependent with technology independent synthesis of digital architecture.
5. Implement low power synthesis technique to reduce power consumption in digital architecture
6. Perform netlist optimization and Formal verification of the digital architecture
7. Perform various timing analysis of the digital architecture
8. Physical Synthesis of Digital Architecture
9. Physical Verification of digital architecture
10. Analyze the performance parameters of a gate-level and physical synthesis digital architecture

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO1: Design a digital architecture and perform logical and timing synthesis.	Apply
CO2: Perform physical synthesis and physical verification of digital architecture.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	1	-	-	-	1	1	-	1	2	2
CO2	3	-	-	-	1	-	-	-	1	1	-	1	2	2

High = 3, Medium = 2, Low = 1

Reference Book:

R1. Laboratory Manual Prepared by Faculty of EE(VLSI) Dr. Mahalingam College of Engineering andTechnology

Course Code: 23ESL601	Course Title: Professional Skills 5: Campus to Corporate (Common to all B.E/B.Tech Programmes)		
Course Category: SEC		Course Level: Higher	
L:T:P (Hours/Week) 0: 0: 2	Credits: 1	Total Contact Hours: 30	Max Marks: 100

Course Objectives:

To enhance students' problem-solving skills in the aptitude segment while also equipping them with effective communication skills for professional settings and success in the interview process.

Module I Verbal Ability & Effective Communication 15 Hours

Verbal Ability

Parts of Speech – Tenses – Subject Verb Agreement – Synonyms – Antonyms – Idioms and Phrases - One Word Substitution – Reading Comprehension – Cloze test – Error Spotting.

Verbal Enhancement

Self-Introduction – Just A Minute- Picture Perception - Writing Skills: Sentence Types (Simple, Compound, Complex), Email drafting.

Campus to Corporate

Professional Grooming –Group Discussion – Impromptu – Interview.

Module II Quantitative & Reasoning Ability 15 Hours

Quantitative Ability

Simplification & Approximation, Number System, Percentage, Averages, Ratios and Proportion, Ages, Profit & Loss, Interest Calculation, Time and work, Time, speed and distance, Clocks and Calendar, Mixtures and alligation, Permutations and Combinations, Probability, Mensuration, Data Interpretation, Data Sufficiency

Reasoning Ability

Seating Arrangement, Blood relations, Directions Problems, Syllogisms, Number & Alpha Series, Coding and Decoding, Non Verbal Reasoning, Analogies, Cubes and Dices.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Exhibit strong problem-solving skills in the aptitude segment while enhancing their communication abilities for professional settings, enabling them to excel in interviews and placement processes.	**Apply**

Textbook(s):

T1: Technical Communication, 3E: Principles and Practice book. Authors. Meenakshi Raman, Sangeeta Sharma, 2006

T2: Pease, Allan, and Barbara Pease. "The Definitive Book of Body Language." Bantam, 2006.

T3: Dr. R. S. Aggarwal. “Quantitative Aptitude for Competitive Examinations” Sultan Chand & Sons Pvt. Ltd, New Delhi, 2024

T4: Dr. R. S. Aggarwal. “A Modern Approach to Verbal and Non-Verbal”, Sultan Chand & Sons Pvt. Ltd, New Delhi, 2024

Reference Book(s):

R1: Cheryl Hamilton, “Communicating for Results: A Guide for Business and the Professions”, 11th edition (1 January 2017), Wadsworth Publishing Co Inc.

R2: Whitcomb, Susan Britton. Resume Magic: Trade Secrets of a Professional Resume Writer. JIST Works, 2010.

R3: Carnegie, D. (2009). The Quick and Easy Way to Effective Speaking. Pocket Books.

R4: Arun Sharma. “Quantitative Aptitude for Common Aptitude Test”, McGraw Hill Publications, 5th Edition, 2020

R5: Arun Sharma. “Logical Reasoning for Common Aptitude Test”, McGraw Hill Publications, 6th Edition, 2021.

Web References:

1 https://www.linkedin.com/pulse/interview-etiquette-dos-donts-interviews-brian-vander-waal-fmy8e/
2 https://www.simplilearn.com/group-discussion-tips-article
3 https://talentbattle.in
4 https://www.geeksforgeeks.org/aptitude-questions-and-answers/

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	1							2	3	3		1		

High-3; Medium-2; Low-1

Vertical I

Analog VLSI Design

Course Code: 23EVE001	Course Title: Active Filters Design		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

To enable students to understand and design first-order and second-order filters, including low-pass, high-pass, band-pass, band-stop, and all-pass filters; analyse GM-C and switched capacitor filters; and implement active filter designs with Butterworth and Chebyshev responses, emphasizing filter transfer functions and frequency response

Module I **22 Hours**

First order filter – Bilateral transfer functions and frequency response – first order: low pass, high pass, band pass, band stop and act pass Filters -Second order: low pass – high pass-band pass - band stop and ACL pass filter

Module II **23 Hours**

Gm-c filter- elementary trans conductance, building blocks - Switched capacitor filters: First order building blocks-second order builders block- butterworth - chebyshev filter response and pate locator (active filter design) - Filter transfer function.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply transfer functions to design and analyze first-order second-order filters**.**	Apply
CO 2: Apply Gm-C filter principles and switched capacitor filter building blocks to design first-order and second-order filters.	Apply
CO 3: Analyze the response of Butterworth and Chebyshev filters using transfer functions and pole-zero locations.	Analyze
CO 4: Analyze switched capacitor filter designs and their transfer functions, focusing on Butterworth and Chebyshev responses in active filter applications.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book(s):

T1.S.A. Pactitis, “Active Filters Theory and Design” Taylor & Francis, 2008.
T2.Allen Waters, “Active Filters Theory and Design” Macmillan New Electronics,1991

Reference Book(s):

R1. Wai Kai Chen, “Passive and Active Filters”, Theory and Implementation,1986
R2. Carson Chen, “Active Filter Design” Hayden Books, 1982
R3. Lawrence P. Huelsman, “Active and Passive Analog Filter Design” 1993

Web References:

1. Active Filter Design - NPTEL
2. Active Analog Filter Design – IEEE Xplore

Course code: 23EVE002	Course Title: Design of CMOS Phase Lock Loop		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course enables students to design and analyse Phase-Locked Loop (PLL) systems. They will develop skills in constructing PLL blocks, evaluating noise impacts, and integrating these components for practical applications.

Module 1 **22 Hours**

Phase-Locked Loop (PLL) Fundamentals Basic PLL topology, Dynamics of simple PLL, XOR phase detector, drawbacks of simple PLL - Phase frequency detector and charge pump, Charge pump PLL, PFD/CP non-idealities, Up and down skew, Channel length modulation, Random mismatches, Clock feedthrough and charge injection, improved charge pumps - Loop filter, loop dynamics and stability analysis, higher order loops - Ring and LC oscillators, tuning in oscillators, Voltage controlled oscillators

Module II **23 Hours**

Advanced PLL Concepts and Noise Analysis: Noise in various building blocks of PLL, Noise in time and frequency domains, Jitter and phase noise in PLLs, Phase noise and power trade-off - Integer-N and Fractional-N frequency synthesizers, pre-scalers and dividers, spur reduction techniques - All digital PLLs, All-digital phase detectors, All-digital loop filters, digitally controlled oscillators

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Build the various blocks of PLL	Apply
CO 2: Construct the PLL systems and perform various analysis.	Apply
CO 3: Assess the impact of various noise sources and considerations in a PLL system	Analyze
CO 4: Integrate building blocks of PLL to realize applications.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	3	-	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book

1. "Phase-Locked Loops: Design, Simulation, and Applications" by Roland E. Best, 2015.
2. "Design of CMOS Phase-Locked Loops: From Circuit Level to Architecture Level" by Behzad Razavi. 2020.
3. "Digital Phase-Locked Loops: Architectures and Applications" by Saleh Sheikholeslami

Reference Books

1. "Phase-Locking in High-Performance Systems: From Devices to Architectures" by Behzad Razavi , 2002.
2. "Analog and Digital Phase-Locked Loops" by Ravikanth Kshirsagar.

Web References

1. https://archive.nptel.ac.in/courses/108/106/108106184/
2. https://onlinecourses.nptel.ac.in/noc22_ee92/preview

Course code: 23EVE003	Course Title: High-Speed Interconnects for VLSI Design		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course aims to enable students to design and implement high-speed interconnects in ASICs, addressing challenges in signal integrity, noise, and delay. Students will learn advanced techniques for optimizing interconnect performance using simulation tools and design strategies.

Module 1 **22 Hours**

Introduction to High-Speed Interconnects: Importance of interconnects in VLSI circuits, Challenges of high-speed interconnects (signal loss, delay, noise) **Transmission Line Theory:** Basic concepts: Resistance, capacitance, and inductance in interconnects, Signal delay and reflection in interconnects **Signal Integrity:** How signals degrade in interconnects (attenuation, crosstalk), Methods to maintain signal quality

Module II **23 Hours**

Designing Interconnects: Techniques to reduce signal delay and improve speed, Importance of layout design to reduce noise and interference. **High-Speed Signalling:** Differential signalling (e.g., LVDS) for faster data transmission, improving performance (e.g., using shielded traces), Simulation Tools for Interconnects: Analysing interconnects using SPICE simulation - interconnect delay and noise.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO 1: Apply fundamental principles of high-speed interconnect design to analyze and solve practical challenges related to signal loss, delay, noise, and integrity in VLSI circuits	Apply
CO 2: Apply principles of transmission line theory to model resistance, capacitance, and inductance in interconnects and evaluate their effects on signal integrity.	Apply
CO 3: Design and optimize high-speed interconnects by implementing differential signalling, shielded traces, and SPICE simulation to minimize signal delay and noise.	Analyse
CO 4: Analyse interconnect design techniques, high-speed signalling methods, and SPICE simulation results to assess delay, noise, and performance improvements in VLSI systems.	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book

T1 H B Bakog Lu, Circuits, “Interconnections and packaging for VLSI”, Addison Wesley publishing company. 1990.

T2 J A Davis, J D Meindl, “Interconnect technology and design for Gigascale integration”, Kluwer academic publishers, 2012.

T3 Nurmi J, Tenhumen H, Isoaho J, Jantsch A, “Interconnect Centric deisgn for advanced SOC
and NOC”, Springer.2004.

Reference Books

R1. C K Cheng, J Lillis, S Lin, N Chang, “Interconnect analysis and synthesis”, Wiley interscience. 1999.

R2. Hall S H, G W Hall and J McCall, High speed digital system design, Wiley interscience.2000.

R3. Askok K Goel, “High speed VLSI interconnections”, Wiley interscience, second edition,
2007.

Web References

1. https://onlinecourses.nptel.ac.in/noc22_ee125/preview

Course code: 23EVE004		Course Title: Art of Analog Layout design	
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course aims to equip students with the knowledge and skills required to design layouts to optimize performance, and arrive at industry standard circuits.

Module 1 **22 Hours**

Introduction to Analog Layout: CMOS Technology –overview**, Introduction to analog layout design-** Challenges, layout considerations, and design rules. **Key Layout Concepts:** Parasitics: Capacitance, resistance, and inductance in analog ICs. - Design Rule Checking (DRC) and Layout vs. Schematic (LVS) - Matching Principles: Common-centroid layout, interdigitation, and symmetry. **Device-Level Layout Considerations:** Layout of transistors (MOSFETs, BJTs) - Capacitors, resistors, and inductors - Guard rings, shielding, and latch-up prevention.

Module II **23 Hours**

Operational Amplifier Layout Basics: Layout of input differential pairs, gain stages, and output drivers - Matching considerations for minimizing offsets. **Design Validation and Tools:** Post-layout simulation basics - Introduction to parasitic extraction tools. **Case Study:** Hands-on example: Layout design of basic analog circuits –current mirror, Differential amplifier, Operational amplifier.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply CMOS analog layout principles to design DRC- and LVS-compliant circuits.	Apply
CO 2: Apply advanced layout techniques to optimize performance, reliability, and manufacturability.	Apply
CO 3: Design and validate complex analog layouts using industry-standard tools	Analyse
CO 4: Analyze operational amplifier layout techniques and post-layout simulation results to evaluate matching, offsets, and parasitic effects in analog circuits.	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	1
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Book

T1 *Hastings, A., "The Art of* Analog Layout", Prentice Hall, 2nd Edition, 2005.

Reference Books

R1: Baker, R. J., "CMOS Circuit Design, Layout, and Simulation", Wiley-IEEE Press, 3rd Edition, 2010.

R2: Weste, N., Harris, D., "CMOS VLSI Design: A Circuits and Systems Perspective", Pearson Education, 4th Edition, 2010.

R3: Allen, P. E., Holberg, D. R., "CMOS Analog Circuit Design", Oxford University Press, 3rd Edition, 2011.

Web References

1. NPTEL - Analog IC Design and Layout
2. IEEE Xplore - Advanced Analog Layout Techniques
3. YouTube - Analog Layout Techniques for Beginners

Vertical II
Digital VLSI Design

Course code: 23EVE005	Course Title: Digital IC Design		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to equip students with a knowledge on design of digital circuits and memory elements in CMOS technology and improve performance using high speed and low power design techniques.

Module 1 **22 Hours**

Introduction to Digital IC Design, CMOS Transistors: Basic structure of a CMOS Implementation, Role of CMOS in digital circuits. Inverters: Operation, Static characteristics: Voltage transfer characteristics. **Logic Gates:** CMOS Implementation of AND, OR, NOT, NAND, NOR. combine logic gates to create simple circuits.

Module II **23 Hours**

Sequential Logic Circuits: Basic memory elements: Flip-flops and latches-Simple sequential circuits like counters. **Dynamic Logic Circuits:** Introduction, Implementation to realize faster circuits. Low Power Design Techniques, High-Speed Circuit Design techniques.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply CMOS principles to design digital circuits and determine inverter behavior.	Apply
CO 2: Apply CMOS to implement basic logic gates and combine them to design simple circuits.	Apply
CO 3: Analyze flip-flops, latches, and simple sequential circuits like counters.	Analyze
CO 4: Analyze dynamic logic circuits for high-speed and low-power design implementations.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	1	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Books

T1 "CMOS Digital Integrated Circuits: Analysis and Design" by Sung-Mo Kang and Yusuf Leblebici,

T2 "Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, 2003.

T3 "Digital VLSI Chip Design with Cadence and Synopsys CAD Tools" by Erik Brunvand, 2009.
T4 CMOS VLSI Design: A Circuits and Systems Perspective by Neil H.E. Weste and David Harris, 2010.

Reference Books

R1. "Introduction to CMOS VLSI Design" by Neil H. E. Weste and David Harris
R2. "Design of Analog CMOS Integrated Circuits" by Behzad Razavi, 2000.
R3 "Principles of CMOS VLSI Design" by Neil H. E. Weste and David Harris, 2016.
R4 Modern VLSI Design: IP-Based Design by Wayne Wolf, 2008.
R5 Digital Design of Signal Processing Systems: A Practical Approach by Shoab Ahmed Khan, 2011.

Web References

1. https://onlinecourses.nptel.ac.in/noc21_ee22/preview
2. https://www.iitg.ac.in/eee/syllabus-details.php?slno=R0VVSGZBbzhaUTY wVEhEV2RWWUVVQT09
3. https://www.cadence.com/en_US/home/training/all-courses/86305.html

Course code: 23EVE006		Course Title: VLSI Digital Signal Processing	
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course covers optimization techniques in VLSI DSP systems, focusing on algorithms, iteration bounds, pipelining, parallel processing, retiming, and unfolding. It also explores bit-level arithmetic architectures, redundant arithmetic, and low-power design methods for efficient DSP implementation.

Module 1 **22 Hours**

Introduction to DSP systems: Representation of DSP algorithms; Iteration Bound: Definition, Examples, Algorithms for computing Iteration bound; **Pipelining and Parallel Processing:** Definitions, Pipelining and parallel processing of FIR filters, Pipelining and parallel processing for low power; Retiming: Definitions and Properties, Solving system of Inequalities, Retiming techniques; Unfolding: Definition, An algorithm for unfolding, Applications of unfolding

Module II **23 Hours**

Bit-Level arithmetic architectures: Parallel multipliers, Bit-serial multipliers, Bit-Serial FIR filter design and Implementation; Redundant arithmetic: Redundant number representation, Carry-free radix-2 addition and subtraction, radix-2 hybrid redundant multiplication architectures; **Low-power design:** Theoretical background, Scaling versus power consumption, Power analysis, Power reduction techniques, Power estimation approaches.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Explain the various representation of DSP algorithms	Understand
CO 2: Analyze parallel processing, pipelining, retiming, and unfolding methods for optimizing digital system performance.	Analyze
CO 3: Analyze bit-level arithmetic and redundant arithmetic for efficient DSP architectures.	Analyze
CO 4: Analyze low-power design concepts, power optimization techniques, and power estimation strategies.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Books

T1 U. Meyer-Baese, DSP with FPGA, Springer, 2004.
T2 K. K. Parhi, VLSI DSP Systems, Wiley, 2003.
T3 R.G. Lyons, Understanding Digital Signal Processing, Pearson Education, 2004.

Reference Books

R1 Prithviraj Kabisatpathy, Fault-Tolerant Architectures for Cryptography and Hardware Security, 2018
R2 Charles E. Ebeling, An Introduction to Reliability and Maintainability Engineering, 1997
R3 Razavi, RF Microelectronics, Pearson Education, 2011

Web References

1. https://www.ece.umn.edu/users/parhi/SLIDES/chap2.pdf
2. https://www.oreilly.com/library/view/vlsi-digital-signal/9780471241867/sec-1.1.html
3. https://ieeexplore.ieee.org/document/1172148

Course code: 23EVE007	Course Title: Scripting Language for Electronic Design Automation		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course aims to teach students to use TCL and PERL for automating tasks in EDA, including data manipulation, tool integration, and GUI development with TCL Tk. Students will learn advanced scripting techniques for optimizing workflows in VLSI and circuit design automation.

Module I **22 Hours**

TCL Basics: Tool Command Language (TCL) fundamentals: Syntax, variables, expressions, and string processing, TCL Lists and control structure commands, Procedures, scope, TCL arrays, Working with files and programs. **PERL Basics:** History and concepts of PERL, Data types: Scalars, arrays, and lists, Control structures and basic I/O, Regular expressions and functions.

Module II **23 Hours**

Advanced TCL: Quoting issues, regular expressions, and script libraries, Reflection and debugging, Namespaces and event-driven programming, Internationalization and socket programming. **PERL Advanced Concepts:** Directory access and manipulation, Process management, packages, and modules, TCL Tool Kit (TK Basics), Fundamentals of TK (Tool Kit), Geometry managers: Pack, grid, and place, Binding commands to events, Working with TK widgets.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand TCL fundamentals, including syntax, control structures, and file handling for scripting applications.	Understand
CO 2: Apply PERL programming concepts, including data types, control structures, I/O, regex and functions, to develop scripting solutions	Apply
CO 3: Analyze advanced TCL features for efficient scripting in VLSI design and verification	Analyze
CO 4: Evaluate PERL advanced concepts and TCL TK toolkit for efficient automation and GUI development in VLSI design.	Evaluate

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	1	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	1	-
CO4	-	-	-	3	-	-	-	-	-	-	-	-	2	1

High = 3, Medium = 2, Low = 1

Text Book

T1: John K. Ousterhout, Ken Jones, “Tcl and the Tk Toolkit”, Pearson Education, Second Edition, 2010.
T2:"Practical Programming in Tcl and Tk" by Brent B. Welch (Addison-Wesley Professional, 2003).
T3:"Perl Best Practices" by Damian Conway (O'Reilly Media, 2005).

Reference Books

R1: LarryWall, Tom Christiansen, John want, “Programming PERL”, Oreilly Publications, 4th ed 2012
R2: Naveed Sherwani, Algorithms for VLSI physical design Automation, Kluwer Academic Publishers, 2013.
R3:"Learning Perl" by Randal L. Schwartz, brian d foy, Tom Phoenix (O'Reilly Media, 7th Edition, 2011).
R4:"The Art of Unix Programming" by Eric S. Raymond (Addison-Wesley, 2003).

Web References

1. https://ieeexplore.ieee.org/document/915211
2. https://www.researchgate.net/publication/3893221_Scripting_for_EDA_tools_a_case_study
3. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=0a1c072d36dcbec44fd4b14e431d1544c915f1c4

Course code: 23EVE008		Course Title: Memory Devices and Circuits	
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course aims to equip students with the knowledge and skills on the design and operation of volatile and non-volatile memory, including CMOS circuits, DRAM, FLASH, and memory compilers, with insights into next-generation memory technologies.

Module 1 **22 Hours**

Types of Memory: Volatile Memory, Non-Volatile Memory, On-chip memory, On-chip Memory types. Review of CMOS circuit design, Sensing circuitry basics, Read/ Write assist circuitry and other peripheral circuitries, Next generation SRAM cell.

Module II **23 Hours**

Introduction to DRAM, High speed DRAM architectures Operation of FLASH memories (FLASH array sensing and programming), Charge Pump circuits. Basic of memory compiler for SRAM architecture using scripting language, Memory unit in MPU/MCU.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Analyze memory types, CMOS design, sensing circuits, and next-gen SRAM for VLSI development.	Analyze
CO 2: Analyze DRAM, high-speed DRAM architectures, FLASH memory operations, array sensing, programming, and charge pump circuits for advanced memory systems.	Analyze
CO 3: Design and optimize SRAM architecture using memory compilers and scripting languages, focusing on memory units in MPU/MCU for advanced system integration	Create

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	1	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO3	-	-	3	-	-	-	-	-	-	-	-	-	2	1

High = 3, Medium = 2, Low = 1

Text Book

T1 "Memory Devices and Circuits: Design and Applications" by Jean-Michel Gorce and François Lemoine.

T2 "CMOS VLSI Design: A Circuits and Systems Perspective" by Neil Weste and David Harris, 2010

T3 "High-Speed Digital Design: A Handbook of Black Magic" by Howard Johnson and Martin Graham, 1993

T4 "Memory Systems: Cache, DRAM, Disk" by Bruce Jacob, Spencer Ng, and David Wang, 2008.
T5 "Design of Analog CMOS Integrated Circuits" by Behzad Razavi, 2000.

Reference Books

R1. "Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, 2003
R2. "Design of CMOS VLSI Circuits for Telecommunications" by Ramon P. S. Mahadevan and William R. F. sS. R. Mahadevan
R3."CMOS Digital Integrated Circuits: Analysis and Design" by Sung-Mo Kang and Yusuf Leblebici, 2002.
R4."Low-Power CMOS VLSI Circuit Design" by Kaushik Roy and Sharat C. Prasad, 2009.

Web References

1. https://www.taylorfrancis.com/books/mono/10.1201/9781003138747/semiconductor-memory-devices-circuits-shimeng-yu
2. https://online.stanford.edu/courses/ee309a-semiconductor-memory-devices-and-circuit-design
3. https://www.sciencedirect.com/journal/memories-materials-devices-circuits-and-systems

Course code: 23EVE009	Course Title: Verification Methodologies		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course covers key verification methodologies, including simulation-based, formal, and coverage-driven approaches, with a focus on UVM-based verification. It teaches testbench construction, constraint-random testing, and advanced techniques for efficient verification.

Module 1 **23 Hours**

Introduction to Verification: Definition and importance of verification, types of verification (functional, performance, etc.), and its role in the design cycle. **Verification Methodologies:** Formal verification, simulation-based verification (test benches, directed tests, random tests). **Test bench Architecture:** Components of a test bench (driver, monitor, checker, scoreboard), stimulus generation, and response checking. **Coverage-Driven Verification:** Code coverage (line, branch, expression), functional coverage, and assertions for measuring verification completeness.

Module II **22 Hours**

Introduction to UVM: Overview of the Universal Verification Methodology (UVM), its core components (test, environment, agent, etc.), and its benefits. **UVM Test Bench Architecture:** Building a UVM test bench using the standard UVM components, including configuration, transaction-level modelling, and score boarding. **Constraint-Random Verification:** Using constraints to generate random test cases, achieving high functional coverage and accelerating verification**. Advanced UVM Techniques:** Register model, sequence library, coverage analysis, and debugging techniques for efficient verification.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand verification types and methodologies (formal, simulation-based) in the design cycle, including test benches and random tests.	Understand
CO 2: Analyze test bench components and coverage-driven verification techniques to assess verification completeness	Analyze
CO 3: Construct and enhance UVM test benches by utilizing core components, configuration, transaction-level modeling, and score boarding for robust verification..	Apply
CO 4: Analyze constraint-random verification and advanced UVM techniques to optimize test case generation, coverage, and debugging for efficient verification.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	1	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	2
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Books:

T1:Vanessa R. Copper, “Getting started with UVM: A Beginner’s Guide”, Verilab Publishing, First Edition, 2013.

T2:Ray Salmei, “The UVM Primer: A Step-by-Step Introduction to the Universal Verification Methodology” Boston Light Press; First edition, 2013.

T3:Ravi B. R., "UVM Cookbook: A Practical Guide to the Universal Verification Methodology", Xilinx Press, 2016.

Reference Books

R1:Christian B Spear, “System Verilog for Verification: A guide to learning the Testbench language features”, Springer publications, Third Edition, 2012.

R2:Janick Bergeron, “Writing Testbenches using System Verilog” Synopsys Inc., Springer Publications, 2006.

R3:Adam T. McNeill, "Advanced Digital Design with the Verilog HDL", Wiley, 2nd Edition, 2011.

R4:Brian L. Evans, "Verification Methodology Manual for SystemVerilog", Springer, 2011.

R5:Ashok B. Mehta, "Digital Design and Verification with SystemVerilog", Pearson Education, 2015.

Web References

1. https://semiengineering.com/knowledge_centers/eda-esign/verification/methodology/
2. https://www.design-reuse.com/articles/54702/importance-of-vlsi-design-verification-and-its-methodologies.html
3. https://www.acldigital.com/blogs/understanding-role-verification-and-validation-vlsi-product-development

Vertical III
VLSI Applications

Course code: 23EVE010	Course Title: VLSI Architectures for Image and Video Processing		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week) 3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course covers VLSI architectures for image and video processing, focusing on DSPs, application-specific ICs, and advanced techniques like mapping algorithms to hardware and optimizing arithmetic operations. It aims to equip students with the knowledge to design efficient, real-time processing systems.

Module 1 **23 Hours**

Fundamentals of Image Processing: Overview of image processing tasks, low-level and intermediate-level operations, Requirements for image processor architectures. **Systems for Image and Video Processing:** Standard DSPs and application-specific ICs for image and video processing, SHARC and Blackfin processors: memory management, on-chip resources, and real-time implementation.

Module II **22 Hours**

Mapping Algorithms to VLSI Architectures: Mapping DSP algorithms to hardware: uniprocessor, shared memory, and vector-multiplier-based implementations, Isomorphic mapping of SFGs, numerically equivalent implementations, and Single Instruction Computers (SIC). **Optimized Arithmetic in VLSI Systems:** Bit-serial and digit-serial arithmetic, CORDIC algorithms, and shift-accumulator optimization, Implementation of FFT processors, address generators, twiddle factors, and control PEs for efficient image and video processing.

Course Outcomes At the end of this course, students will be able to:	Cognitive Level
CO 1: Apply the fundamental concepts of image processing, including tasks, operations, and architectural requirements for image processors.	Apply
CO 2: Analyze image and video processing using DSPs, ICs, and SHARC/Blackfin processors with a focus on memory management and real-time implementation.	Analyze
CO 3: Analyze DSP algorithms for VLSI using uniprocessor, shared memory, and vector-multiplier architectures with isomorphic mapping.	Analyze
CO 4: Analyze and optimize arithmetic for VLSI using bit-serial/digit-serial techniques, CORDIC, shift-accumulator, and FFT processors.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	1
CO3	-	3		-	-	-	-	-	-	-	-	-	2	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	-

High = 3, Medium = 2, Low = 1

Text Books

T1:Lars Wanhammer, “DSP Integrated Circuits”, Elsevier India Pvt. Ltd, New York, 2012.
T2:Phil Lapsley, Jeff Bier, AmitSholam and Edward A.Lee, “DSP Processor Fundamentals-Architectures, and Features”, Wiley India, reprint 2011.
T3:X. Liu and K. Chakrabarty, *VLSI Architectures for Video Compression: Algorithms and Hardware Design Techniques*, Wiley, 2007.
T4:K. K. Parhi, VLSI Digital Signal Processing Systems: Design and Implementation*, Wiley-Interscience, 1999.*

Reference Books

R1:A.V.Oppenheim et.al, “Discrete-time Signal Processing”, Pearson Education, 2013.
R2:Steven W. Smith, “The Scientist and Engineer's Guide to Digital Signal Processing”, 1998
R3:P.P.Vaidyanathan, Multirate Systems & Filter Banks, Prentice Hall, Englewood cliffs, NJ, 199

Web References

1. https://ieeexplore.ieee.org/document/735383
2. https://link.springer.com/chapter/10.1007/978-1-4612-2018-3_14
3. https://ieeexplore.ieee.org/document/7559816

Course code: 23EVE011	Course Title: VLSI design for Neural Networks		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course introduces the fundamentals of neural networks and VLSI design, focusing on key concepts such as neural network architecture, activation functions, and hardware requirements. It explores VLSI design trade-offs, efficient architectures, and optimization techniques for power and performance, with practical applications in FPGA prototyping and ASIC design.

Module 1 **22 Hours**

Introduction to Neural Networks: Basics of neural networks: architecture, activation functions, and learning methods, Hardware requirements: scalability, parallelism, and power efficiency. **VLSI Design Fundamentals for Neural Networks:** Key VLSI design concepts: trade-offs in area, power, and speed, Hardware mapping of neural networks: memory, pipelining, and parallelism, Arithmetic considerations: fixed-point vs. floating-point implementations.

Module II **23 Hours**

VLSI Architectures for Neural Networks: Processing elements: multipliers, accumulators, and activation units, Efficient architectures: systolic arrays, memory compression, and quantization. **Optimization and Advanced Techniques:** Power and performance optimization: pruning, clock gating, and sparsity exploitation, Real-time implementation: FPGA prototyping and ASIC design.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Analyze neural networks and hardware requirements for application suitability.	Analyze
CO 2: Analyze key VLSI design concepts, hardware mapping of neural networks, and arithmetic considerations for efficient implementations.	Analyze
CO 3: Apply VLSI architectures for neural networks, including processing elements and efficient architectures.	Apply
CO 4: Analyze the effectiveness of pruning, clock gating, and sparsity exploitation in real-time systems.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	3	-	-	-	-	-	-	-	-	-	-	-	-
CO2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	1

High = 3, Medium = 2, Low = 1

Text Books

T1:"Digital VLSI Design and Simulation with Verilog" by Suman Lata Tripathi , 2021

T2:"VLSI Design for Signal, Speech, and Image Processing**"** by Kailash J. Karande

T3:"VLSI Design: A Practical Introduction" by J. Douglas Neath and Zainalabedin Navabi

Reference Books

R1:"VLSI Signal Processing Systems" by Keshab K. Parhi, 1999

R2:"Deep Learning for Computer Architects" by Brandon Reagen, Robert Adolf, Paul Whatmough, and David Brookss, 2017

R3:"Neural Networks and Learning Machines" by Simon Haykin, 2007

Web References

1. van den Bout, D., Franzon, P., Paulos, J. *et al.* Scalable VLSI implementations for neural networks. J VLSI Sign Process Syst Sign Image Video Technol **1**, 367–385 (1990). https://doi.org/10.1007/BF00929928
2. https://www.researchgate.net/publication/12311499_VLSI_Implementation_of_Neural_Networks
3. https://ieeexplore.ieee.org/abstract/document/100386

Course code: 23EVE012	Course Title: VLSI for wireless Communications		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course covers wireless communication systems, modulation techniques, and error correction. It focuses on the design of VLSI receivers and frequency synthesizers, emphasizing mixers, noise, and power efficiency.

Module 1 **22 Hours**

Wireless Systems and Standards: Overview of wireless communication systems, key standards (e.g., Wi-Fi, cellular, Bluetooth), and their applications. **Modulation and Demodulation:** Introduction to digital modulation techniques (e.g., QAM, PSK), their power and bandwidth efficiency, and demodulation methods. **Channel Coding:** Error correction techniques (e.g., convolutional codes, turbo codes) for reliable data transmission over noisy channels.

Module II **23 Hours**

Mixer Design: Analysis and design of active (e.g., Gilbert cell) and passive (e.g., switching) mixers, including considerations for linearity, noise figure, and conversion gain. **Frequency Synthesizer Design**: PLL-based frequency synthesizers, including phase detector, charge pump, VCO, and loop filter design. Analysis of phase noise and spurious signals.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Apply techniques to analyze wireless communication systems, modulation methods for ensuring reliable transmission.	Apply
CO 2: Apply channel coding techniques for error correction in noisy channels.	Apply
CO 3: Analyze the design of active and passive mixers, focusing on linearity, noise figure, and conversion gain.	Analyze
CO 4: Analyze the performance of PLL-based frequency synthesizers, focusing on phase noise and spurious signals.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	1
CO3	-	3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	2

High = 3, Medium = 2, Low = 1

Text Books

T1:Bosco Leung, "VLSI for Wireless Communication, Second Edition, Springer,2011.

T2:Wen-Chih Kan,“VLSI Architecture for High-capacity Wireless Communications”, University of Minnesota, 2007.

T3:P. Vijay Kumar, P. Pramod, *"VLSI Design for Wireless Communication Systems"*, Wiley, 2014.

Reference Books

R1:Emad N Farag, M.I Elmasry, “Mixed Signal VLSI Wireless Design Circuits and Systems”, Kluwer Publications, 2013.

R2:David Tsee, Pramod Viswanath,” Fundamentals of Wireless Communication”, Cambridge Univ Press, 2005.

R3:Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004.

Web References

1. https://www.design-reuse-embedded.com/industryexpertblogs/vlsi-design-future-of-wireless-communication/
2. https://www.analog.com/en/applications/technology/wireless-communication.html
3. https://www.cadence.com/en_US/home.html

Course code: 23EVE013	Course Title: Integrated Circuits for Optical Communication		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course explores the role of integrated circuits (ICs) in optical communication systems, covering the basics of optical IC design, including waveguides and amplifiers, and advanced topics like amplifiers, oscillators, PLLs, and high-speed transmitter circuits for efficient optical signal processing.

Module 1 **23 Hours**

ICs in Optical Communication Systems: Importance of ICs in communication: CATV signal distribution, capacity, coverage, and optical bandwidth, Key factors: insertion loss, polarization sensitivity, reconfiguration time, and blocking properties, Optical amplifier designs and gate switch matrix examples. **Optical Integrated Circuits**: Features and basics- waveguide theory, design, and fabrication, Components: gratings, passive waveguides, and functional waveguide devices, Practical examples and applications of optical ICs.

Module II **22 Hours**

Amplifiers and Oscillators: Trans-impedance amplifiers (TIA): open-loop, feedback, and high-performance techniques, Amplification strategies: broadband techniques and distributed amplification, Oscillators: ring, LC, voltage-controlled oscillators, and distributed oscillators. **PLL and Transmitter Circuits:** PLLs: charge pump PLLs, delay-locked loops, and applications, High-speed designs: clock data recovery (CDR), jitter considerations, and multiplexers, Laser and modulator drivers for high-speed transmission.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Explore the role of ICs in optical communication systems, focusing on key factors and amplifier designs.	Understand
CO 2: Analyze the design and components of optical integrated circuits, focusing on waveguide theory and its applications..	Analyze
CO 3: Analyze amplifiers and oscillators, focusing on TIA techniques, amplification strategies, and oscillator designs..	Analyze
CO 4: Analyze PLL circuits, high-speed designs, and transmitter circuits for high-speed transmission applications.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	-	1
CO2	-	3	-	-	-	-	-	-	-	-	-	-	-	2
CO3	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	-	3	-	-	-	-	-	-	-	-	-	-	1	-

High = 3, Medium = 2, Low = 1

Text Books

T1:Behzad Razavi, “Design of Integrated circuits for optical communication”, Wiley & Sons Ltd, 2012.

T2:Hiroshi Nishihara, Masamitsu Haruna, and Toshiaki Suhara, “Optical Integrated Circuits”, McGraw-Hill, New York, 2002.

T3:Edmond J.Murphy(ed), “Integrated Optical Circuits and Components: Design and Applications”, World scientific Publishing Ltd, U.S.A, 2002**.**

Reference Books

R1:R. J. Hsu, "Optical Integrated Circuits: Materials and Devices", Springer, 2009.

R2:M. S. Zied, "Integrated Optics: Theory and Technology", Springer, 2008.

R3:Paul W. Krug, "Optical Fiber Communications: Principles and Practice", Pearson, 2013.

Web References

1. van den Bout, D., Franzon, P., Paulos, J. *et al.* Scalable VLSI implementations for neural networks. *J VLSI Sign Process Syst Sign Image Video Technol* **1**, 367–385 (1990). https://doi.org/10.1007/BF00929928
2. https://download.e-bookshelf.de/download/0000/6447/78/L-G-0000644778-0002366091.pdf
3. https://ieeexplore.ieee.org/document/1017945

Vertical IV
Fabrication and Advanced Design Techniques

Course code: 23EVE014	Course Title: Microchip Fabrication		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course aims to provide an in-depth understanding of the principles and techniques involved in the fabrication of microchips. It covers semiconductor materials, processes like photolithography and etching, advanced techniques in device integration, and explores modern trends in semiconductor manufacturing.

Module 1 **22 Hours**

Introduction to Semiconductor Manufacturing: Evolution of microchip fabrication - Overview of semiconductor materials and properties. **Photolithography:** Principles of optical lithography - Mask alignment and exposure systems. **Deposition Techniques:** Chemical Vapor Deposition (CVD), Physical Vapor Deposition (PVD) - Atomic Layer Deposition (ALD) - Etching Processes: Wet etching and dry etching techniques - Plasma and reactive-ion etching processes. **Thermal Oxidation and Diffusion: Oxidation** mechanisms - Doping and diffusion techniques

Module II **23 Hours**

Metallization and Planarization: Interconnect technologies and chemical-mechanical polishing - Transistor Fabrication and Device Integration: MOSFETs, FinFETs, and multi-layer device challenges - Packaging and Testing: Wafer-level packaging, testing strategies, and failure analysis - **Advanced Manufacturing Techniques:** EUV lithography, 3D ICs, and emerging materials like carbon nanotubes. - Sustainability in **Semiconductor Manufacturing:** Green manufacturing and reducing environmental impact.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Explain the fundamental processes in microchip fabrication, including material preparation and lithography.	Understand
CO 2: Apply key techniques like deposition and etching to design simple semiconductor devices.	Apply
CO 3: Analyze advanced fabrication challenges and propose sustainable solutions for modern semiconductor processes.	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Book

T1:Stephen A. Campbell, *The Science and Engineering of Microelectronic Fabrication*, 2001.

T2:S. M. Sze and Kwok K. Ng, *Physics of Semiconductor Devices*. 2008.

Reference Books

R1:Simon Sze, *VLSI Technology*. 2017.

R2:Michael Quirk and Julian Serda, *Semiconductor Manufacturing Technology*. 2000.

Web References

1. IEEE Xplore Digital Library
2. Semiconductor Engineering Articles

Course code: 23EVE015	Course Title: Power Management and Clock Distribution		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course provides an understanding of power management strategies and clock distribution techniques in modern electronic systems. It focuses on low-power design methodologies, clock generation, and distribution challenges in high-performance digital systems, aiming to optimize energy efficiency and clock signal integrity.

Module 1 **23 Hours**

Introduction to Power Management: Power dissipation in CMOS systems - Active, static, and dynamic power consumption, Low-Power Design Techniques: Voltage scaling, power gating, and clock gating - Dynamic Voltage and Frequency Scaling (DVFS), **Power Delivery Networks (PDN):** Components of PDNs (VRMs, decoupling capacitors, etc.) - PDN impedance and stability considerations, Thermal Management: Heat dissipation techniques.

Module II **22 Hours**

Basics of Clocking in Digital Systems: Clock generation (PLL, DLL) - Characteristics of a clock signal: skew, jitter, and duty cycle, **Clock Distribution Techniques:** H-tree, mesh, and hybrid clock distribution - Clock routing challenges and optimization, Low-Power Clocking: Clock gating and dynamic clock adjustment - Techniques to minimize clock power consumption, Emerging Clocking Trends: Resonant clocking techniques - Optical and wireless clock distribution

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand power consumption sources and apply low-power design strategies..	Understand
CO 2: Design efficient power delivery and thermal management systems for electronic circuits.	Apply
CO 3: Analyze and implement robust clock distribution networks for high-performance systems.	Analyse

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Books

T1:Jan Rabaey, *Low Power Design Essentials*. 2009.

T2:D. Harris and S. Harris, *Digital Design and Clocking Techniques*.

Reference Books

R1:S. M. Kang and Y. Leblebici, *CMOS Digital Integrated Circuits: Analysis and Design*. 2002.

R2:K. Roy and S. Prasad, *Low-Power CMOS VLSI Circuit Design*. 2009.

Web References

1. IEEE Xplore Digital Library
2. Semiconductor Engineering Articles

Course code: 23EVE016	Course Title: Reliability in VLSI Circuits		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

To understand reliability challenges in VLSI circuits, analyze failure mechanisms, and design solutions for improving reliability in semiconductor devices and systems.

Module 1 **23 Hours**

Failure Mechanisms in VLSI Circuits: Electromigration, time-dependent dielectric breakdown (TDDB), and hot carrier injection (HCI) - Negative bias temperature instability (NBTI) and positive bias temperature instability (PBTI) - Impact of aging on device reliability, **Reliability Modelling:** Statistical methods for reliability prediction - Fault tree analysis and failure mode effects analysis (FMEA) - Monte Carlo simulations for reliability assessment

Module II **22 Hours**

Reliability Enhancement Techniques: Error detection and correction codes (EDAC) - Redundancy and fault-tolerant design for VLSI circuits - Techniques for improving device lifetime and reliability, **Testing and Validation of Reliability:** Accelerated life testing and stress testing for VLSI devices - Built-in self-test (BIST) for reliability assurance - Reliability-aware design tools and methodologies

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand failure mechanisms affecting VLSI circuits.	Understand
CO 2: Analyze and model reliability issues in semiconductor devices.	Analyze
CO 3: Apply design techniques to enhance reliability and validate circuits.	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	3	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Books

T1;S. M. Sze, *VLSI Technology*, 2017

T2: Mohammad Tehranipoor, *Emerging Topics in Hardware Security*. 2021

Reference Books

R1:Prithviraj Kabisatpathy, *Fault-Tolerant Architectures for Cryptography and Hardware Security*. 2018

R2:Charles E. Ebeling, *An Introduction to Reliability and Maintainability Engineering*.1997

Web References

1. IEEE Xplore Digital Library
2. Semiconductor Engineering Articles

Course code: 23EVE017	Course Title: Synthesis and Optimization of VLSI Circuits		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

To understand reliability challenges in VLSI circuits, analyse failure mechanisms, and design solutions for improving reliability in semiconductor devices and systems.

Module 1 **23 Hours**

Introduction to VLSI Synthesis: Overview of VLSI design flow and synthesis steps, Design representations: RTL, FSMs, and Boolean equations, Basics of logic synthesis: two-level and multi-level logic synthesis**. Combinational and Sequential Circuit Synthesis:** Technology mapping for logic circuits- gate-level implementation and library binding, Sequential synthesis: retiming, state assignment, and pipelining, Optimizing area, power, and delay constraints.

Module II **22 Hours**

Optimization Techniques: Logic optimization: minimization, don't-care conditions, and factoring, Power optimization: clock gating, power gating, and low-power techniques, **Timing optimization:** static timing analysis, critical path balancing. **Advanced Topics and Tools:** High-level synthesis (HLS): behavioral optimization and scheduling, **Emerging trends:** machine learning in synthesis, 3D IC optimization, and physical design considerations.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand the various logical synthesis	Understand
CO 2: Apply synthesis techniques to realize netlist for digital circuits	Apply
CO 3: Apply optimization techniques to enhance the performance of digital circuits	Apply
CO 4: Apply high level synthesis techniques to design digital ICs	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Books

T1:""Logic Synthesis and Verification" by Gary D. Hachtel and Fabio Somenzi , 1996

T2:"VLSI Physical Design Automation" by Sadiq M. Sait and Habib Youssef, 1995

T3:"Principles of CMOS VLSI Design: A Systems Perspective" by Neil H.E. Weste and David Harris

Reference Books

R1:"High-Level Synthesis: Introduction to Chip and System Design" by Michael Fingeroff, 2010

R2:"Modern VLSI Design: IP-Based Design" by Wayne Wolf, 2008

R3:"Digital Integrated Circuits: A Design Perspective" by Jan M. Rabaey, Anantha Chandrakasan, and Borivoje Nikolic, 2003

R4:"Computer-Aided Logical Design witsh Emphasis on VLSI" by Frederick J. Hill and Gerald R. Peterson, 1993

Web References

1. IEEE Xplore Digital Library
2. Semiconductor Engineering Articles

Course code: 23EVE018	Course Title: I IP core design and protection		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to equip students with a knowledge in IP core design, apply IP core protection, and improve security and reliability in IP cores.

Module 1 **23 Hours**

Introduction to IP Cores: Overview of IP cores: definition, types, and role in system-on-chip (SoC) design, Design flow for creating IP cores: specifications, architecture, and integration, Key considerations: area, power, performance, and reusability. **IP Core Design Techniques:** Standardization and modular design: reusable building blocks, Design abstraction levels: RTL, behavioural, and structural, Verification strategies for IP cores: functional verification, simulation, and test benches.

Module II **22 Hours**

IP Core Protection Mechanisms: Methods of IP protection: encryption, watermarking, and obfuscation, Legal protection: licensing models, patents, and copyrights, Counterfeit and piracy prevention in IP core designs. **Security and Reliability in IP Cores:** Techniques for securing IPs against reverse engineering and tampering, Hardware Trojan detection and prevention, Reliability and fault tolerance in IP cores for critical applications.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Explain the IP core design flow.	Understand
CO 2: Utilize IP core design techniques to develop systems	Apply
CO 3: Apply protection mechanisms for IP cores	Apply
CO 4: Apply techniques to improve security and reliability in IP cores	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Books:

T1:"IP Core Design and Verification" by Laung-Terng Wang, Yung-Yu Chuang
T2:"Designing SoCs with Configured IPs" by Ricardo Reis

T3:"Digital Design and Computer Architecture: ARM Edition" by Sarah Harris and David Harris, 2015.

Reference Books

R1:"The Art of IP Protection: Hardware and Software Solutions" by Steven H. Voldman, 2005.
R2:"Design for Trustworthy Software: Tools, Techniques, and Methodology for Development" by Daniel W. H. Bowers
R3:"Practical Cryptography for Developers" by Svetlin Nakov, Dimitar Kirov
R4:"Hardware Security: Design, Threats, and Safeguards" by Jason G. R. S. De Lemos and Eduardo L. V. L. P, 2014.

Web References

1. IEEE Xplore Digital Library
2. Semiconductor Engineering Articles

Course code: 23EVE019	Course Title: Electronics Packaging		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

This course provides an overview of electronic packaging technologies, materials, and techniques used in assembling and protecting electronic components and systems. It emphasizes thermal management, reliability, and advanced packaging solutions to meet modern performance and miniaturization demands.

Module 1 **22 Hours**

Introduction to Electronic Packaging: Packaging levels (chip-level, board-level, and system-level) - **Packaging Materials:** Properties of packaging materials- thermal, mechanical, and electrical - Substrates, adhesives, and encapsulants, **Interconnection Technologies:** Wire bonding, flip-chip, and Through-Silicon Via (TSV) technologies - Soldering and surface mount technology (SMT), **Failure Mechanisms and Reliability:** Thermal, mechanical, and environmental stresses - sTesting and reliability analysis

Module II **23 Hours**

Advanced Packaging Techniques: 3D packaging and chip stacking - System-in-Package (SiP) and Package-on-Package (PoP), **High-Speed Packaging Design:** Signal integrity and power integrity in high-speed systems - Electromagnetic interference (EMI) considerations, **Future Trends in Packaging:** Photonic packaging, MEMS packaging.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand the fundamental concepts, materials, and techniques used in electronic packaging.	Understand
CO 2: Apply thermal management and reliability analysis techniques to enhance packaging performance.	Apply
CO 3: Analyse advanced packaging solutions to address challenges in modern electronics.	Analyze

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	-	3	3
CO3	-	3	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Books:

T1:Tummala Rao, *Fundamentals of Microsystems Packaging*. 2001.

T2:Blackwell, *Electronic Packaging and Interconnection Handbook*. 2000.

Reference Books

R1:Charles A. Harper, *Electronic Packaging and Interconnection Technologies*. 1991.

R2:Glenn R. Blackwell, *High-Performance Integrated Circuit Packaging*. 1999.

Web References

1. IEEE Xplore Digital Library
2. Articles on Advanced Packaging and System Design

Course code: 23EVE020	Course Title: Thin Film Characterization		
Course Category: Major		Course level : Higher / Advanced	
L:T:P(Hours/Week)3: 0: 0	Credits:3	Total Contact Hours:45	Max Marks:100

Course Objective:

The course is intended to equip students with a knowledge in basics of thin film characterization, conventional and advanced techniques used.

Module 1 **22 Hours**

Introduction to Thin Films: Definition, types, and deposition techniques - CVD, sputtering, evaporation, Key applications of thin films in electronics, optics, and coatings, Importance of characterizing thin films for quality control. **Basic Characterization Techniques:** Surface Morphology: Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM), Structure Analysis: X-ray Diffraction (XRD), Transmission Electron Microscopy (TEM), Thickness Measurement: Ellipsometry, Spectroscopic Reflectance.

Module II **23 Hours**

Optical Properties: Measurement of refractive index, optical bandgap, and reflectance. Techniques: Spectroscopic Ellipsometry and Reflectance/Transmittance methods. **Electrical and Mechanical Properties:** Electrical Testing: Four-Point Probe, Hall Effect, and Van der Pauw methods. Mechanical Testing: Hardness, adhesion, stress measurements. Reliability Testing: Thermal cycling and environmental testing.

Course Outcomes	Cognitive Level
At the end of this course, students will be able to:	
CO 1: Understand the basic thin film characterization techniques	Understand
CO 2: Understand the optical parameters in characterization.	Understand
CO 3: Arrive at electrical and mechanical characteristics .	Apply

Course Articulation Matrix

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO2	-	-	-	-	-	-	-	-	-	-	-	-	2	2
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	3

High = 3, Medium = 2, Low = 1

Text Book

T1: "Thin Film Materials: Synthesis, Characterization, and Applications" by G.C. Cates

T2: "Characterization of Materials" by Elton N. Kaufmann, 2003.

Reference Books

R1:"Thin Film Deposition: Principles and Practice" by Donald L. Smith, 1994

R2:"Thin Films: Their Physics and Applications" by R. F. Bunshah,

Web References

1. IEEE Xplore Digital Library
2. Articles on Advanced Packaging and System Design