ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B. E. Electronics Engineering (VLSI Design and Technology) **Regulations: 2025**

Abbreviations:

HUM – Humanities (Languages, Management, Heritage, and others)

BS – Basic Science (Mathematics, Physics, Chemistry)

ES – Engineering Science (General (**G**), Programme Core (**PC**), Programme Elective (**PE**) & Emerging Technology (**ET**))

SD – Skill Development

SL – Self Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP – Total Contact Period(s)

Program Outcomes

1. **Engineering Knowledge**: Apply math, science, and engineering fundamentals to complex problems.
2. **Problem Analysis**: Identify and analyze complex problems using research and sustainability principles.
3. **Design Solutions**: Design systems and processes considering health, safety, cost, culture, and environment.
4. **Investigations**: Use experiments, modelling, and data analysis to reach valid conclusions.
5. **Engineering Tools**: Apply modern tools for modelling and problem-solving, recognizing their limits.
6. **Society & Environment**: Assess societal, legal, and environmental impacts of engineering solutions.
7. **Ethics**: Commit to ethics, human values, diversity, and legal compliance.
8. **Teamwork**: Work effectively as an individual and in multidisciplinary teams.
9. **Communication**: Communicate clearly in reports, presentations, and documentation across diverse groups.
10. **Management & Finance**: Apply management and economic principles in projects and teamwork.

11. **Lifelong Learning**: Engage in continuous learning, adapt to new technologies, and think critically.

Program Specific Outcomes:

1. To design, develop, and implement efficient VLSI systems and embedded hardware in real-time applications.
2. Utilize modern tools and hardware description languages in complex integrated circuits and systems.
3. To keep pace with rapid advancements in the field of VLSI technology and demonstrate research aptitude, collaborate effectively in teams and uphold ethical practices.

Semester – I							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C01	Applied Calculus	T	3-1-0	4	4	BS
2.	EN25C01	English Essentials – I	T	2-0-0	2	2	HUM
3.	UC25H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	HUM
4.	EE25C04	Basic Electronics and Electrical Engineering	T	2-1-0	3	3	ES (PC)
5.	PH25C01	Applied Physics – I	LIT	2-0-2	4	3	BS
6.	CY25C01	Applied Chemistry – I	LIT	2-0-2	4	3	BS
7.	CS25C01	Computer Programming: C	LIT	2-0-2	4	3	ES (G)
8.	ME25C04	Makerspace	L	0-0-4	4	2	SD
9.	UC25A01	Life Skills for Engineers – I	---	1-0-2	3	1	HUM
10.	UC25A02	Physical Education – I	---	0-0-4	4	1	HUM
11.		NCC / NSS / NSO / YRC	---	---	---	---	---
Total Credits					**33**	**23**	

Semester – II							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C02	Linear Algebra	T	3-1-0	4	4	BS
2.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	HUM
3.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
4.	EC25C01	Electron Devices	T	3-0-0	3	3	ES (PC)
5.	EC25C02	Circuits and Network Analysis	T	3-0-0	3	3	ES (PC)
6.	CS25C05	Data Structures using C++	LIT	3-0-2	5	4	ES (G)
7.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
8.	EC25C03	Devices and Circuits Laboratory	L	0-0-4	4	2	ES (PC)
9.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
10.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
11.		Foreign Language^	LIT	1-0-2	3	1	HUM
			Total Credits		**37**	**24**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C11	Probability, Statistical and Random Processes	T	3-1-0	4	4	BS
2.	EC25C04	Signals and Systems	T	3-1-0	4	4	ES (PC)
3.	VL25301	Digital Logic Design	T	3-0-0	3	3	ES (PC)
4.	VL25302	Analog Circuits	T	3-0-0	3	3	ES (PC)
5.	CS25301	Python Programming	LIT	2-0-2	4	3	ES (PC)
6.	VL25303	Digital Logic Design Laboratory	L	0-0-4	4	2	ES (PC)
7.	VL25304	Analog Circuits Laboratory	L	0-0-4	4	2	ES (PC)
8.		Skill Development Course – I	LIT	1-0-2	3	2	SD
9.	EN25C03	English Communication Skills Laboratory – I	L	0-0-2	2	1	HUM
			Total Credits		**31**	**24**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	VL25401	Graph Theory for VLSI Engineers	T	3-0-0	3	3	ES (PC)
2.	VL25402	Digital VLSI Design	T	3-0-0	3	3	ES (PC)
3.	VL25403	Introduction to Standards in VLSI Design	T	1-0-0	1	1	ES (PC)
4.	EC25C15	Linear Integrated Circuits	T	3-0-0	3	3	ES (PC)
5.	EC25C06	Electromagnetic Fields and Transmission Lines	T	3-0-0	3	3	ES (PC)
6.	VL25404	Microprocessors, Microcontrollers and Interfacing	T	3-0-2	5	4	ES (PC)
7.		Skill Development Course – II	LIT	1-0-2	3	2	SD
8.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
9.	EC25C16	Linear Integrated Circuits Laboratory	L	0-0-4	4	2	ES (PC)
10.	VL25405	Digital VLSI Design Lab	L	0-0-4	4	2	PC
Total Credits					**31**	**24**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Control Systems	T	3-0-0	3	3	ES (PC)
2.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
3.		Computer Architecture and Organization	T	3-0-0	3	3	ES (PC)
4.		Analog and Digital Communication	T	3-1-0	4	4	ES (PC)
5.		Analog CMOS IC Design	LIT	3-0-2	5	4	ES (PC)
6.		Discrete Time Signal Processing	LIT	3-0-2	5	4	ES (PC)
7.		Skill Development Course – III	LIT	1-0-2	3	2	SD
		Industry Oriented Course - I	LIT	1-0-2	3	1	SD
9.		Analog and Digital Communication Laboratory	L	0-0-4	4	2	PC
Total Credits					**33**	**26**	
For Honours Degree							
1.		Capstone Design Project – Level I	CDP	0-0-12	12	6	SD
(OR)							
1.		Honours Elective – I	T	3-0-0	3	3	

2.		Honours Elective – II	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – I	T	3-0-0	3	3	
2.		Minor Elective – II	T	3-0-0	3	3	

Semester – VI							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		RTL Design and Verification	LIT	3-0-2	5	4	ES (PC)
2.		Programme Elective – II	T	3-0-0	3	3	ES (PE)
3.		Programme Elective – III	T	3-0-0	3	3	ES (PE)
4.		Open Elective	T	3-0-0	3	3	ES (OE)
5.		Algorithms for VLSI Physical Design Automation	LIT	3-0-2	5	4	ES (PC)
6.		Deep Learning Architecture	T	3-0-0	3	3	ES (PC)
7.		VLSI Physical Design	LIT	3-0-2	5	4	ES (PC)
8.		Self-Learning Course	---	---	0	1	SL
9.		Industry Oriented Course - II	LIT	1-0-2	3	1	SD
				Total Credits	**30**	**26**	
For Honours Degree							
1.		Capstone Design Project – Level II	CDP	0-0-12	12	6	SD
(OR)							
1.		Honours Elective – III	T	3-0-0	3	3	
2.		Honours Elective – IV	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – III	T	3-0-0	3	3	
2.		Minor Elective – IV	T	3-0-0	3	3	

Semester – VII

S. No.	Course Code	Course Name	Course Type	Periods / Week		Credits	Category
				L-T-P	TCP		
1.		Engineering Entrepreneurship Development	T	2-0-2	4	3	HUM
2.		Climate Change and Sustainability	T	2-0-0	2	2	HUM
3.		System on Chip Design	T	3-0-0	3	3	ES (PC)
4.		Hardware Security	T	3-0-0	3	3	ES (PC)
5.		VLSI Testing and Design for Testability	T	3-0-0	3	3	ES (PC)
6.		Project Management	T	2-0-0	2	2	HUM
7.		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
8.		Programme Elective – V	T	3-0-0	3	3	ES (PE)
9.		Industrial Training*	---	---	---	1	SD
Total Credits					**23**	**23**	
For Honours Degree							
1.		Capstone Design Project – Level III	CDP	0-0-12	12	6	SD
(OR)							
1.		Honours Elective – V	T	3-0-0	3	3	
2.		Honours Elective – VI	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – V	T	3-0-0	3	3	
2.		Minor Elective – VI	T	3-0-0	3	3	

Semester – VIII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1		Project Work / Internship cum Project Work	PW / IPW	0-0-16	16	8	SD
Total Credits					**16**	**8**	

Total Periods - 179

PROGRAMME ELECTIVE COURSES – STREAMS:

Semiconductor Devices and Technology	Chip Design and Testing	Electronics Circuits and System Design	Communication and Signal Processing	IoT and Applications	Display Technologies
Semiconductor Device Modeling	ASIC Design	Data Converters	RF IC Design	Embedded Systems and IoT Design	Thin Film Transistors
Fundamentals of Nano Electronics	Validation and Testing Technology	Reconfigurable Architectures	Microwave Engineering	Wireless Sensor Network Design	OLEDs and LCDs
Advanced Semiconductor Devices	Network On Chip	Power Management and Clock Distribution	EMI / EMC Pre Compliance Testing	IoT Processors	Principles of Nanomaterials and Quantum Dots
Wide bandgap devices	Mixed Signal IC Design	Multicore Architecture and Programming	Digital Image and Video Processing	IoT Protocols and security	Display Systems Design
Quantum Electronics	Low Power IC Design	VLSI Design of Neural Networks	Software Defined Radio	Industrial IoT and Industry 4.0	Light Management Films
Nano Sensors and Devices	Reliability in VLSI Circuits	Neuromorphic Computing Architecture	VLSI Signal Processing	Embedded System Design using FPGAs	Touch Panel Technology

Semester I

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

- To provide technical competence of modelling engineering problems using calculus.
- To apply the calculus concepts in solving engineering problems using analytical

methods and computational tools.

Differential Calculus: Functions, graph of functions, New functions from old functions, Limit of a function, Continuity, Limits at infinity, Derivative as a function, Maxima and Minima of functions of single variable, Mean value theorem, Effect of derivatives on the shape of a graph.

Activities: Visualization of the functions, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Functions of Several Variables: Partial derivatives, Chain rule, Total derivative, Maxima and minima of functions of two variables, Method of Lagrange's Multipliers, Application problems in engineering.

Activities: Partial Derivatives with two or three variables, Maxima and Minima of a function using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Integral Calculus: Fundamental theorem of Calculus, Indefinite integrals and the Net Change Theorem, Improper integrals, Arc Length, Area of Region, Area of surface of revolution.

Activities: Definite and Indefinite Integrals, Determination of Area, Solving of Competitive Examination questions (Ex. GATE).

Multiple Integrals: Iterated integrals and Fubini's theorem, Evaluation of double integrals, change of order of integration, change of variables between Cartesian and polar co-ordinates, evaluation of triple integrals-change of variables between Cartesian and cylindrical and spherical co-ordinates.

Activities: Double integrals and triple integrals using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving of GATE questions (20%), Internal Examinations (40%).

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.
2. Ron Larson and David C. Falvo,(2013), Calculus: an Applied Approach. Cengage Learning.
3. Stewart, J., Clegg, D., & Watson, S. (2019). *Calculus: Early transcendentals*.
4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2018). *Thomas' calculus: Early transcendentals*. Pearson.
5. Singh, K. (2019). *Engineering mathematics through applications*. Bloomsbury

Publishing.
6. Grewal, B. S. (2012). *Higher engineering mathematics.* Khanna Publishers.

E-resources:

1. https://math.libretexts.org/Bookshelves/Calculus/Map%3A_Calculus__Early_Transcendentals_(Stewart)/
2. https://openstax.org/books/calculus-volume-1/
3. https://tutorial.math.lamar.edu/Classes/CalcII/CalcII.aspx
4. SCILAB, https://www.scilab.org/

	Description of CO	PO	PSO
CO1	Explain the meaning of derivative, integral, and their geometric and physical interpretations.	---	---
CO2	Apply differentiation and integration techniques to compute maxima, minima, and area.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyze the behavior of single and multivariable functions using derivatives and partial derivatives.	PO2(3)	PSO1(2) PSO3(1)
CO4	Utilize modern computational software and online platforms to deepen understanding, perform complex calculations, and visualize mathematical concepts.	PO5(2) PO11(1)	PSO2(3) PSO3(1)

EN25C01	English Essentials – I	L	T	P	C
		2	0	0	2

Course Objectives:

- Enhance learners' listening and speaking skills to understand and deliver speeches effectively
- Equip students with the skills to write clear, coherent, and grammatically correct texts for various purposes.
- Strengthen the ability to comprehend, interpret, and analyse written English across diverse contexts.

Speaking Skills: Self-Introduction (Tenses, Adjectives) Expressing opinions (Subject-Verb Agreement), Participating in Conversations (Speech Acts - agreeing & disagreeing – synonyms and antonyms**)**

Suggested Activities: Self-Introduction, Just a Minute (JAM) Video recording, Situational role plays, Spell Bee, Word Substitution, Usage of Apps.

Listening Skills: Listening to Simple Conversations (Understanding tone and intent), Short Speeches / Stories, Extracting information, Pronunciation, Listening to Various Accents.

Suggested Activities: Listening and Repeating, Gap fill exercises, Note-taking

Reading Skills: Reading Strategies – (Skimming, scanning, predicting) intensive reading - short passages and long passages on suggested themes (Sentence Patterns, Prefixes and suffixes, idioms and phrases).

Activities: Reading - newspaper and digital articles, Cloze, Reading comprehension, note making and summarising,

Writing Skills: Word Substitution, Sentence Formation, Hints Development (Guided Writing), Writing Different Types of Paragraphs - (Sentence Structure) – Letter Writing / Emails (Informal)

Activities: Error Detection, Picture and poster description, Descriptive, Narrative and Comparative paragraphs, Brainstorming and Mind Mapping - Informal letters/ Emails

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (20%), Speaking Task (10%), Reading Task (10%), Writing Task (10%), Internal Examinations (40%).

References:

1. Miller, K. Q., & Wahl, S. T. (2023). *Business and Professional Communication: KEYS for Workplace Excellence* (5th ed.). SAGE Publications.
2. Kumar, Sanjay & Pushpalatha. (2018). *English Language and Communication Skills for Engineers*. India: Oxford University Press.
3. Sharma, S., & Mishra, B. (2024). *Communication Skills for Engineers and Scientists* (2nd ed.). PHI Learning.

E-resources:

1. Cambridge English – https://www.cambridgeenglish.org/learning-english/grammar-and-vocabulary/
2. Perfect English Grammar – https://www.perfect-english-grammar.com/

3. British Council – Learn English - https://learnenglish.britishcouncil.org/grammar
4. Speechling – https://speechling.com/
5. mePro by Pearson – https://mepro.pearson.com/
6. TED Talks – https://www.ted.com/

	Description of CO	**PO**	**PSO**
CO1	Listen and comprehend spoken English, take and draft notes.	---	---
CO2	Apply vocabulary and grammar appropriately to communicate in written and spoken forms.	PO1(3)	PSO1(2) PSO3(3)
CO3	Analyze texts in different contexts using appropriate reading strategies.	PO2(2)	PSO2(1)
CO4	Communicate thoughts and ideas in real life situations.	PO9(2)	PSO3(2)
CO5	Develop communication skills relevant to engineering and technology.	PO11(1)	PSO3(3)

UC25H01	தமிழர் மரபு	L	T	P	C
		1	0	0	1

மொழி மற்றும் இலக்கியம்: 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.

மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: 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.

நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

தமிழர்களின் திணைக் கோட்பாடுகள்: தமிழகத்தின் தாவரங்களும், விலங்குகளும், தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள், தமிழர்கள் போற்றிய அறக்கோட்பாடு, சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும், சங்ககால நகரங்களும் துறை முகங்களும், சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி, கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு, இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம், சுயமரியாதை இயக்கம், இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு, கல்வெட்டுகள், கையெழுத்துப்படிகள், தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

References:

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 சங்ககால 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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

UC25H01	Heritage of Tamils	L	T	P	C
		1	0	0	1

Language and Literature: 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.

Heritage - Rock Art Paintings to Modern Art – Sculpture: 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.

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

Thinai Concept of Tamils: 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.

Contribution of Tamils to Indian National Movement and Indian Culture: 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.

References:

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 சங்ககால 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) (Publishedby: The Author)

11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

EE25C04	Basic Electronics and Electrical Engineering	L	T	P	C
		2	1	0	3

Course Objectives:

- Students will understand the fundamentals and evolution of electronics, electrical systems

Basic Electronics: Passive and active components – Resistors, Capacitors, Inductors- Types, features and specification, Energy band diagram of conductors, semiconductor, insulator – Intrinsic & extrinsic semiconductor - types. PN junction diode – zener diode.

Activities: VI characteristics of PN junction and Zener diode.

Electrical Machines: Construction, Principle of Operation, Basic Equations and Applications - DC Generators, DC Motors, Single Phase Transformer, Single phase Induction Motor, Three phase Induction Motor, Three phase Alternator, Stepper and BLDC motors.

Activities: Demonstration of Electrical Machines.

Measurements and Instrumentation: Functional elements of an instrument, Standards and calibration, Operating Principle, types - Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition.

Activities: Demonstration of measuring equipment's

Basics of Power Systems: Power system structure -Generation, Transmission and distribution , Various voltage levels, Earthing – methods of earthing, protective devices- switch fuse unit- Miniature circuit breaker- moulded case circuit breaker- earth leakage circuit breaker, safety precautions and First Aid

Activities: Demonstration of Earthing and safety precautions in electrical circuits

Sensors and Transducers

Solenoids, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, piezo electric crystals, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (10%), Assignments (40%), Internal Examinations (50%)

References:

1. Bell, D. (2008). *Electronic devices and circuits*. Oxford University Press.
2. Tooley, M. A. (2006). *Electronic circuits: Fundamentals and applications*. Elsevier Limited.
3. Malvino, A., & Bates, D. J. (2012). *Basic electronics: Problems and solutions*. Tata

McGraw-Hill Publishing Company Pvt. Ltd.
4. Hughes, E. (2016). *Electrical and electronic technology*. Pearson.
5. Theraja, B. L. (2014). *A textbook of electrical technology*. S. Chand & Company.

E- Resources:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science
2. https://www.khanacademy.org/science/electrical-engineering

	Description of CO	**PO**	**PSO**
CO1	Understand and explain basic electrical and electronic concepts.	---	-
CO2	Apply and analyse electrical circuits in real-time applications.	PO1 (3) PO2 (1)	PSO1(3)
CO3	Identify and utilise key electrical and electronic devices used in engineering applications	PO2 (3)	PSO2(3)

PH25C01	Applied Physics – I	L	T	P	C
		2	0	2	3

Course Objective(s):

- To impart knowledge and expose the essentials of physics in various engineering applications.

Properties of Matter: Elasticity, Cantilever –Young's modulus (non-uniform bending), Girders: Bridges and buildings, Viscosity: Stokes method – Surface tension: drop weight method, Thermal expansion, Thermal stress, Bimetallic strips, Expansion joints

Practical: Non-Uniform bending, Young's modulus of the material, Torsional pendulum, Rigidity modulus of the wire and moment of inertia of the disc.

Activities: Virtual demonstration of thermal stress.

Oscillations: Simple Harmonic motion, Torsional pendulum, Couple per unit twist, Damped and Forced Oscillation

Waves: Waves on a stretched string, Energy and Power, standing waves, Ultrasonics, piezo-electric method, Acoustic grating, Electromagnetic waves: Maxwell equation, Production of EM waves by dipole antenna, Propagation of EM waves in free space, wave equation, Cell phone reception

Practical: Melde's string experiment, Frequency of an electrically vibrating metal tip.

Activities: Virtual demonstration of propagation of EM waves

Quantum Mechanics: Black body radiation, Photoelectric effect, de Broglie hypothesis- Schrodinger Wave equation, Particle in a box (infinite potential well, three-dimensional box), Barrier penetration and quantum tunnelling.

Practical: Photo-electric effect – Determination of Planck's constant.

Activities: Virtual demonstration of Scanning Transmission Electron Microscope

Applied Optics: Interference: Air wedge, Michelson's Interferometer, Fiber optics: Structure of a fiber – Fiber Optic Communication System – Fiber Sensors (Virtual demo) – Displacement, pressure sensor and Temperature sensor - Einstein Co-efficient - Nd:YAG laser, CO_2 laser (construction, functioning and applications), dye laser

Practical: Ruling width of Compact disc using Laser, Thickness of a thin sheet/wire using Air wedge Method.

Activities: Demonstration of sensors and applications of Lasers

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Young, H. D., & Freedman, R. A. (2020). University physics with modern physics. Pearson.
2. Gaur, R. K., & Gupta, S. L. (2022). Engineering physics. Dhanpat Rai Publications.
3. Mathur, D. S. (2010). Elements of properties of matter. S. Chand Publishing.
4. Griffiths, D. J. (2018). Introduction to quantum mechanics. Cambridge University Press.
5. Silfvast, W. T. (2008). Laser fundamentals (2nd ed.). Cambridge University Press.

E-resources:

1. Barrier penetration problem and Quantum tunnelling: https://archive.nptel.ac.in/courses/115/104/115104096/
2. EM waves and wireless channelling: https://onlinecourses.nptel.ac.in/noc24_ee31/preview
3. CO2 Laser : https://onlinecourses.nptel.ac.in/noc25_ph03/preview
4. Bimetallic Strips _ https://www.youtube.com/watch?v=WZQ8lvxdzDk
5. Cell phone Reception_ https://www.youtube.com/watch?v=1JZG9x_VOwA
6. Dipole Antenna_ https://www.youtube.com/watch?v=4xF1Fq2wB1I
7. Optical Sensors_ https://auece.digimat.in/nptel/courses/video/108106173/L02.html
8. Scanning Tunnelling Electron Microscope_ https://www.youtube.com/watch?v=XNYZYbXNWQA

	Description of CO	**PO**	**PSO**
CO1	Explain the physics concepts in various applications.	---	---
CO2	Apply the principles of wave optics and laser physics in practical systems.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyse the behaviour of materials under different conditions.	PO2(2)	PSO1(2) PSO3(1)
CO4	Conduct experiments in groups and interpret the data.	PO4(3) PO8(1)	PSO1(2) PSO2(2)

CY25C01	Applied Chemistry – I	L	T	P	C
		2	0	2	3

Course Objectives:

- To provide students with a solid understanding of the chemical principles for engineering applications.
- To introduce the chemical properties of materials and how these properties influence the selection and use of materials in engineering systems.
- To impart practical applications of chemistry in commonly used engineering devices.

Water Technology: Water quality parameters and standards. Industrial feed water, Remediation. Municipal water treatment. Desalination.

Practical: Analysis of alkalinity, hardness and dissolved oxygen.

Activity: Coagulation of water sample using Alum

Nano-chemistry: Classification, Size-dependent properties. Preparation of nanomaterials, Top-down and Bottom-Up approaches, Applications (Flipped classroom).

Practical: Preparation of nanoparticles by Sol-Gel method.

Electrochemistry: Electrochemical cell, Electrode potential Redox reaction. Conductivity of electrolytes, Factors.

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

Corrosion & Control: Chemical and electrochemical corrosions, galvanic series, factors influencing corrosion, Electrochemical protection. Organic and Inorganic coating.

Practical:

• Corrosion study by weight loss and salt spray method.
• Potentiometry/UV-visible spectrophotometer.

Activities: Case Study on Corrosion in Pipelines and Electronics, Control measures for a corroded metal

Batteries: Conventional, Contemporary and Emerging battery storage technologies, Primary & Secondary Batteries, Battery Pack, Battery Materials, Performance Parameters, Testing, Safety aspects.

Practical: Measurement of EMF, Internal Resistance, Charge and Discharge

Characteristics.

Activities: Demonstration of battery pack in e-vehicles.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References:

1. Jain, P. C., & Jain, M. (2015). *Engineering Chemistry*. Dhanpat Rai Publishing Company (P) Ltd.
2. Dara, S. S. (2004). *A Textbook of Engineering Chemistry*. Chand Publications.
3. Sachdeva, M. V. (2011). *Basics of Nano Chemistry*. Anmol Publications Pvt Ltd.
4. Friedrich, E. (2014). *Engineering Chemistry*. Medtech.

E-Resources:

1. Water and Wastewater Engineering (Prof. Ligy Philip, IIT Madras) – https://nptel.ac.in/courses/105106202.
2. Electrochemical Energy Systems (Prof. S. Mitra, IIT Madras) – https://nptel.ac.in/courses/113106028.
3. Corrosion (Prof. Kallol Mondal, IIT Kanpur) – https://nptel.ac.in/courses/112104088
4. Chemistry of Battery Systems (Prof. V. R. Marathe, IIT Madras) – https://nptel.ac.in/courses/115106130
5. Resource on all battery types, testing, and safety – https://batteryuniversity.com/articles

	Description of CO	**PO**	**PSO**
CO1	Understand the importance of chemistry applications with underlying mechanisms.	---	
CO2	Apply the chemistry concepts in widely used devices.	PO1(3)	PSO1(2) PSO2(2)
CO3	Analyse the effect of various chemical parameters on performance of engineering systems.	PO2(2)	PSO1(2) PSO2(1)
CO4	Perform experimentations as a group and interpret the results.	PO4(3) PO8(1)	PSO2(2) PSO3(2)
CO5	Communicate findings through case studies and reports	PO9(1)	PSO2(2) PSO3(3)

CS25C01	Computer Programming: C	L	T	P	C
		2	0	2	3

Course Objectives:

- To equip engineering students with the foundational knowledge and practical skills in 'C' programming to analyse and solve computational problems effectively.
- To foster problem-solving, critical thinking, and modular programming skills essential for engineering domains.

Introduction to C: Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode, program structure, Compilation & Execution process, Interactive and Script mode, Comments, Indentation, Error messages, Primitive data types, Constants, Variables, Reserved words, Arithmetic, Relational, Logical, Bitwise, Assignment, Conditional operators, Input/Output Functions, Built-in Functions.

Practical: Create Problem Analysis Charts, Flowcharts and Pseudocode for simple C programs (Minimum three).

Control Structures: if, if-else, nested if, switch-case, while, do-while, for, nested loops, Jump statements.

Practical: Usage of conditional logics in programs. (Minimum three)

Functions: Function Declaration, Definition and Calling, Function Parameters and Return Types, Call by Value and Call by Reference, Recursive Functions, Scope and Lifetime of Variables, Header files and Modular Programming.

Practical: Usage of functions in programs. (Minimum three)

Strings & Pointers: One-dimensional and Multi-dimensional Arrays, Array operations and traversals, String Handling: String declaration, input/output, string library functions, Pointer arithmetic, Pointers and Arrays, Pointers to function, Dynamic memory allocation.

Practical: Programs using pointers, dynamic memory, pointer arithmetic, string manipulations, array operations. (Minimum three)

Structures & Unions: Defining and using structures, Array of structures, Pointers to structures, Unions and their uses, Enumerations.

Practical: Program to use structures and unions

File Operations: Open, read, write, close file operations, Binary vs Text files, File pointers, Error handling in file operations.

Practical: Programs reading/writing data in text and binary files (Minimum three).

Standard Libraries & Header Files: Using standard libraries like stdio.h, stdlib.h, string.h, math.h, Creating and using user-defined header files and libraries.

Practical: Use of standard and user-defined libraries in solving problems. (Minimum three), Project (Minimum Two)

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Project (15%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)

References:

1. Thareja, R. (2021). Programming in C . Oxford University Press.
2. Balagurusamy, E. (2019). Programming in ANSI C. McGraw Hill Education.
3. Kanetkar, Y. (2020). Let us C. BPB Publications.
4. Kalicharan, N. (2022). Learn to program with C: An introduction to programming using the C language. Apress.
5. Forouzan, B. A., & Afyouni, H. (2023). Computer science: A structured programming approach in C. Cengage.

E-resources:

1. Learn-C.org - https://www.learn-c.org/
2. GeeksforGeeks - C Programming - https://www.geeksforgeeks.org/c-programming-language/
3. GNU C Library Documentation - https://www.gnu.org/software/libc/manual/
4. “Introduction to C Programming”, Swayam MOOC Course, https://onlinecourses.swayam2.ac.in/imb25_mg71/

CO	Description of CO	PO	PSO
CO1	Explain the potential usage of ‘C’ in engineering applications	---	---
CO2	To apply the concepts of ‘C’ in solving engineering problems and formulate new projects.	PO1 (2) PO5 (2)	PSO1(3) PSO3(1)
CO3	To interpret the data and effectively communicate in groups.	PO2 (3) PO8 (1) PO9 (1)	PSO2(3) PSO3(1)
CO4	Adapt new programming concepts and technologies in the profession.	PO11 (1)	PSO2(1), PSO3(3)

ME25C04	Makerspace	L	T	P	C
		0	0	4	2

Course Objectives:

- To impart practical skills in the assembly, disassembly, and welding of components using appropriate tools and techniques.
- To provide hands-on training in electrical wiring practices, and the use of electronic components, sensors, and actuators.

List of Activities

(A). Dis-assembly & Assembly Practices

i. Tools and its handling techniques.
ii. Dis-assembly and assembly of home appliances – Grinder Mixer Grinder, Ceiling Fan, Table Fan & Washing Machine.
iii. Dis-assembly and assembly of Air-Conditioners & Refrigerators.
iv. Dis-assembly and assembly of a Bicycle.

(B). Welding Practices

i. Welding Procedure, Selection & Safety Measures.
ii. Power source of Arc Welding – Gas Metal Arc Welding & Gas Tungsten Arc Welding processes.
iii. Hands-on session of preparing base material & Joint groove for welding.
iv. Hands-on session of MAW, GMAW, GTAW, on Carbon Steel & Stainless Stell plates / pipes, for fabrication of a simple part.

(C). Electrical Wiring Practices

i. Electrical Installation tools, equipment & safety measures.
ii. Hands-on session of basic electrical connections for Fuses, Miniature Circuit Breakers and Distribution Box.
iii. Hands-on session of electrical connections for Lightings, Fans, Calling Bells.
iv. Hands-on session of electrical connections for Motors & Uninterruptible Power Supply.

(D). Electronics Components / Equipment Practices

i. Electronic components, equipment & safety measures.
ii. Dis-assembly and assembly of Computers.
iii. Hands-on session of Soldering Practices in a Printed Circuit Board.
iv. Hands-on session of Bridge Rectifier, Op-Amp and Transimpedance amplifier.
v. Hands-on session of integration of sensors and actuators with a Microcontroller.
vi. Demonstration of Programmable Logic Control Circuit.

(E). Contemporary Systems

i. Demonstration of Solid Modelling of components.
ii. Demonstration of Assembly Modelling of components.
iii. Fabrication of simple components / parts using 3D Printers.
iv. Demonstration of cutting of wood / metal in different complex shapes using Laser Cutting Machine.

References:

1. Stephen Christena, Learn to Weld: Beginning MIG Welding and Metal Fabrication Basics, Crestline Books, 2014.
2. H. Lipson, Fabricated - The New World of 3D Printing, Wiley, 1st edition, 2013.
3. Code of Practice for Electrical Wiring Installations (IS 732:2019)

Course Outcomes:

	Description of CO	PO	PSO
CO1	Demonstrate proper use and handling of basic hand and power tools.	---	---
CO2	Carry out electrical wiring installations and repairs, applying safety measures in domestic applications.	PO1(3)	PSO2(1)
CO3	Develop solid innovative models through software.	PO5(2)	PSO2(2)
CO4	Adapt and follow safety protocols in the work environment.	PO11(2)	PSO3(2)

UC25A01	Life Skills for Engineers – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To equip engineering students with essential life skills encompassing personal and emotional development, effective management of time and stress, financial literacy, digital safety, and civic responsibility.
- To enhance self-awareness, interpersonal skills, and resilience to prepare students for the professional and personal challenges of engineering careers and life beyond academics.

Personal and Emotional Development: Self-Awareness & Personality, Emotional Intelligence & Empathy, Positive thinking, Right attitude, Stress & Anger Management, Goal-Setting & Time Management, Growth Mindset & Resilience.

Activities: Personality tests (MBTI, DISC), reflection journals, Empathy circle, role-playing difficult conversations, Guided mindfulness sessions, stress relief toolkit creation, Vision board creation, weekly time audit and planner, Group challenge scenarios, resilience journal.

Management Skills: Financial Literacy: Budgeting & Saving, Nutrition, Health, and Hygiene, Digital Literacy & Online Safety, Civic Responsibility & Ethics

Activities: Create a monthly budget, financial simulation game, Meal planning workshop, physical wellness challenge, Social media audit, privacy and safety scenarios, Community service, values debate.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. Khera, S. (2003). *You can win*. Macmillan.
2. Levesque, H. (n.d.). *Life skills 101: A practical guide to leaving home and living on your own*. (Publication year not specified)
3. Mitra, B. K. (2017). *Personality development & soft skills* (3rd impression). Oxford University Press.
4. ICT Academy of Kerala. (2016). *Life skills for engineers*. McGraw Hill Education (India) Private Ltd.

	Description of CO	PO	PSO
CO1	Understand personality traits and emotional intelligence, in interpersonal interactions.	---	---
CO2	To work and execute as a team through successful implementation of set goals.	PO7 (1) PO8 (2) PO9 (2)	PSO3(2)
CO3	Develop and implement best practices in day-to-day life, in terms of planning and execution.	PO11 (3)	PSO3(2)

UC25A02	Physical Education - I	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart the fundamentals of physical education for development of students' physical, mental, and social well-being.
- To instill a lifelong appreciation for physical activity towards the development of positive attitude and fostering values of team work and sportsmanship.

Introduction to physical education: Exercise for Good Posture – Conditioning and Calisthenics for Before start, Jogging, Bending, Twisting, Standing, Sitting and Relaxation, Training on First Aid Practices.

Participation of athletic events: Rules and regulations of important athletic events, Sprint, Jumps, Throws and Hurdles.

Skill development in any one of the following outdoor games: Basket Ball, Volley Ball, Ball Badminton, Football, Hockey, Kho-Kho, Kabaddi, Cricket, Hand ball and Tennis.

Skill development in any one of the following indoor games: Shuttle Badminton, Chess and Table Tennis.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.

E-resources:

https://www.who.int/health-topics/physical-activity

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	---
CO2	Apply basic principles of exercise science in the routine life.	PO1(3)	PSO1(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8(3)	PSO3(2)
CO4	Demonstrate independent learning in health, nutrition, and fitness-related topics.	PO11(2)	PSO3(2)

Semester II

MA25C02	Linear Algebra	L	T	P	C
		3	1	0	4

Course Objectives:

- To impart foundational knowledge in linear algebra essential for analysing and solving problems in engineering applications.
- To provide the knowledge on computation using software and interpret key linear algebra concepts using software.

Vector Spaces Introduction to Vector Spaces, Examples, Subspaces, Linear Combinations, Span, Generating Sets, Linear Dependence and Independence, Basis and Dimension, Dimension of Subspaces.

Activities: Open-Source software, exercises to test linear dependence and independence using rank, compute span and basis of a set of vectors, determine the dimension of subspaces, and illustrate the concept of subspace and basis in $\boldsymbol{R^2}/\boldsymbol{R^3}$ with visualization.

Linear Transformations and Diagonalization: Null space, Range, Dimension Theorem (statement only), Matrix representation of a linear transformation, Eigenvalues & Eigenvectors, Diagonalizability.

Activities: Open-Source software, exercises to compute the matrix representation of a linear transformation, find the null space and range of a matrix, and compute eigenvalues and eigenvectors of a matrix.

Inner Product Spaces: Inner product, Norms, Cauchy, Schwarz inequality, Gram, Schmidt orthogonalization, Simple problems (up to $\boldsymbol{R^3}$).

Activities: Open-Source software, exercises to compute inner products and vector norms.

Matrix Decomposition: Orthogonal transformation of a symmetric matrix to diagonal form - Positive definite matrices, QR decomposition, Singular Value Decomposition (SVD), Least squares solutions- simple problems (up to $3 \times 3\ matrices$).

Activities: Open-Source software, exercises to check if a matrix is positive definite, perform QR decomposition and SVD using built-in functions.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2022). *Linear algebra*. Pearson.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). *Linear algebra and its applications with MATLAB*. Pearson.
3. Bronson, R. (2011). *Schaum's outline of matrix operations*. McGraw-Hill Education.
4. Strang, G., & Thomson, R. (2005). *Linear algebra and its applications*. Brooks/Cole.
5. Lipschutz, S., & Lipson, M. (2009). *Schaum's outline of linear algebra*. McGraw-Hill.
6. Kreyszig, E. (2018). *Advanced engineering mathematics*. Wiley India.

	Description of CO	PO	PSO
CO1	Explain the fundamental concepts of Linear Algebra.	---	
CO2	Compute and interpret eigenvalues and eigenvectors.	PO1(3)	PSO1(2)
CO3	Apply inner product concepts and perform orthogonalization.	PO1 (3)	PSO1(1)
CO4	Compute least squares solutions of linear system of equations.	PO1 (2) PO2 (2)	PSO3(1)
CO5	Use MATLAB to implement and validate key linear algebra concepts	PO5 (1) PO11 (1)	PSO2(2)

UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	L	T	P	C
		1	0	0	1

நெசவு மற்றும் பானைத் தொழில்நுட்பம்: சங்க காலத்தில் நெசவுத் தொழில், பானைத் தொழில்நுட்பம், கருப்பு சிவப்பு பாண்டங்கள், பாண்டங்களில் கீறல் குறியீடுகள்.

வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு, சங்க காலத்தில் கட்டுமான 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.

உற்பத்தித் தொழில் நுட்பம்: 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, எலும்புத்துண்டுகள், தொல்லியல் சான்றுகள், சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: அணை, ஏரி, குளங்கள், மதகு, சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம், கால்நடை பராமரிப்பு, கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள், வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள், கடல்சார் அறிவு, மீன்வளம், முத்து மற்றும் முத்துக்குளித்தல், பெருங்கடல் குறித்த பண்டைய அறிவு, அறிவுசார் சமூகம்.

அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: அறிவியல் தமிழின் வளர்ச்சி, கணித்தமிழ் வளர்ச்சி. தமிழ் நூல்களை மின்பதிப்பு செய்தல். தமிழ் மென்பொருட்கள் உருவாக்கம். தமிழ் இணையக் கல்விக்கழகம். தமிழ் மின் நூலகம். இணையத்தில் தமிழ் அகராதிகள். சொற்குவைத் திட்டம்.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References

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 சங்ககால 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) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu).
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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		1	0	0	1

Weaving and Ceramic Technology: Weaving Industry during Sangam Age, Ceramic technology, Black and red Ware Potteries (BRW), Graffiti on Potteries.

Design and Construction Technology: 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 Nayaka rMahal, Chetti Nadu Houses, Indo-Saracenic architecture at Madras during British Period.

Manufacturing Technology: 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 Stonebeads, Glass beads, Terracotta beads, Shell beads/ bone beats, Archeological evidences, Gem stone types described in Silappathikaram.

Agriculture and Irrigation Technology: Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompuof 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.

Scientific Tamil & Tamil Computing: 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.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References

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 சங்ககால 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) (Publishedby: 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.

EN25C02	English Essentials – II	L	T	P	C
		1	0	2	2

Course Objectives:

- Enable learners to improve fluency and accuracy in spoken and written communication.
- Develop learners' ability to articulate ideas clearly and effectively in formal and informal spoken interactions.
- Help learners construct well-organised written documents relevant to academic and workplace contexts.

Oral Communication: Types (Verbal and Nonverbal), Interpersonal and group communication, Telephonic conversation.

Suggested Activities: Short presentations, Debates, Formal Speeches (Welcome, Vote of Thanks and introducing guests), Listen and respond to short podcasts.

Business Correspondence: Email Communication, Formal Letters (Types), Business Meeting.

Suggested Activities: Email and letter writing (Complaint, request, permission), Agenda, minutes of the meeting.

Academic Writing: Paraphrasing, Summarizing, Essay Writing, Instructions and Recommendations.

Suggested Activities: Essay writing (Cause and effect, argumentative, persuasive), User guides/ manuals, policy document.

Team Work: Leadership Skills (Team building, Team Leader, Team player), Negotiation and Problem solving skills

Suggested Activities: SWOT Analysis, Brainstorming and Group discussions.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Worksheets (10%), Group Activity (20%), Report Writing (20%), Internal Examinations (50%)

References:

1. Koneru Aruna. (2020*). English Language Skills for Engineers*. McGraw Hill Education.
2. Taylor, Shirley & Chandra .V. (2010). *Communication for Business A Practical Approach*. India: Pearson Longman.
3. Ian Badger, et al., (2014). *Listening: B2 (Collins English for Life: Skills)*, Collins.
4. Raymond Murphy (2019), *Grammar in Use*, Cambridge University Press.

E-Resources:

1. Communication for Business Success - https://open.umn.edu/opentextbooks/textbooks/8
2. TED Talks – https://www.ted.com/

	Description of CO	PO	PSO
CO1	Understand the importance of communication and drafting skills in engineering and technology.	---	
CO2	Apply listening strategies to comprehend spoken English in various contexts.	PO1(3)	PSO3(2)
CO3	Participate actively in group discussions by analysing critically from different views.	PO2(2) PO8(1)	PSO3(3)
CO4	Create written reports coherently for various purposes.	PO9(2)	PSO3(2)
CO5	Adapt communication styles to global, multicultural environments.	PO11(1)	PSO2(2)

EC25C01	Electron Devices	L	T	P	C
		3	0	0	3

Course Objective:

- To acquaint with the construction, theory and operation of the basic electronic devices such as PN junction diode, Bipolar and Field Effect Transistors, Power control devices, LED, LCD and other Optoelectronic devices.

Semiconductor: Types, Conductivity, Electron energy levels and energy band diagram, Carrier concentration, Mass action law, Characteristics and behavior of intrinsic semiconductors, Variation in properties with temperature, Carrier drift and diffusion, Current density equation, Excess carrier generation and recombination rates, Carrier life time. Continuity equation.

Activity: Virtual demonstration of energy levels, Drift and diffusion current.

PN Junction Diodes: Energy band diagram of open-circuited PN junction, Forward and reverse bias characteristics, Diode resistance, Transition and diffusion capacitance, Effect of temperature on diode behavior, clipper, clamper-Applications of PN junction diodes.

Special Diodes: Zener diode – breakdown mechanisms and voltage regulation, Varactor diode, Tunnel diode, Photo diode – construction, operation, and applications.

Activities: Virtual demonstration of characteristics of junction diodes, Design of a constant voltage regulator using Zener Diode.

Bipolar Junction Transistors: Construction, working, characteristics in CB, CE, and CC configurations, regions of operation, current gain, input/output characteristics, Early effect. Other Devices: Multi-emitter transistor – construction and applications.

Field Effect Transistors: JFET – construction, working, characteristics, parameters. MOSFET, MOS capacitor, depletion and enhancement modes, nMOS and pMOS, threshold voltage, transfer and output characteristics. CMOS – introduction and basic operation.

Thyristors: Shockley diode, Silicon Controlled Rectifier (SCR), TRIAC and DIAC – operation and applications, Thyristor protection techniques**.**

Unijunction Transistor (UJT): Construction, characteristics and application as relaxation oscillator.

Optoelectronic Devices: LED, LCD, Photo transistor, Opto-coupler – principle, characteristics and applications. Power MOSFETs: Construction, switching characteristics and applications in power circuits.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (15%), Assignments (30%), Flipped Class (5%), GATE Questions 10 % Internal Examinations (40%)

References:

1. Neamen, D. A. (2012). *Semiconductor physics and devices*. Tata McGraw-Hill.
2. Boylestad, R. L., & Nashelsky, L. (2008). *Electronic devices and circuit theory*. Pearson Prentice Hall.
3. Yang, C. Y. (1978). *Fundamentals of semiconductor devices*. McGraw-Hill International.
4. Salivahanan, S., Suresh Kumar, N., & Vallavaraj, A. (2008). *Electronic devices and circuits*. Tata McGraw-Hill.
5. Floyd, T. L. (2018). *Electronic Devices: Conventional Current Version*. Pearson.

E-Resources:

1. https://archive.nptel.ac.in/courses/108/108/108108122/
2. https://onlinecourses.nptel.ac.in/noc21_ee80/preview
3. Razavi Electronics 1, Lec 1, Intro., Charge Carriers, Doping
4. Semiconductor Devices: Fundamentals

	CO Description	PO	PSO
CO1	Explain the behavior of Semiconductor physics and its applications in electron devices.	---	
CO2	Apply the concepts and compare the different configuration of various electron devices.	PO1 (3)	PSO1(2)
CO3	Analyze and interpret the characteristics of various electron devices.	PO2 (2)	PSO1(3)
CO4	Perform experiments to evaluate and compare the characteristics of electronic components.	PO2 (2) PO4 (2)	PSO2(2) PSO3(1)

EC25C02	Circuits and Network Analysis	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart the fundamental principles of circuit laws, network theorems, and analysis techniques for DC and AC circuits.
- To gain analytical and simulation skills for both steady-state and transient behaviors in AC and DC circuits.

Circuit Laws and Network Theorems: Basic electrical components, voltage, current, power, Network terminology- Node, Junction, Branch, Loop, Short and Open Circuits, DC and AC circuits, Ohm's Law, Kirchhoff‘s Laws, Resistors, inductors, and capacitors in series and parallel, voltage and current division rule, Mesh and Nodal Analysis for AC and DC circuits, Source transformation techniques, Star delta transformation techniques, principle of linearity, Thevenin’s and Norton’s theorems, Superposition theorem, Maximum power transfer theorem, Reciprocity theorem.

Steady-State and Transient Analysis of Ac and DC Circuits: Components behavior (R, L, and C) in AC and DC, Characteristics of sinusoids, Phasor relationship for R, L, and C, Phasor diagram, Natural and forced response, Steady-state and Transient analysis of RL, RC, RLC circuits using Laplace Transform.

Resonance and Coupled Circuits: Natural frequency and Damping ratio, Series resonance, Parallel resonance, Quality factor (Q), Bandwidth, Selectivity, Effect of Q on bandwidth and selectivity. Self-inductance, Mutual inductance, Dot conversion, Ideal Transformer.

Linear Two-Port Network Analysis: Introduction to two-port networks, Characterization in terms of impedance, admittance, hybrid, and transmission parameters, parameter conversions, Interconnection of two-port networks – Symmetry and Reciprocity.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (15%), Assignments (30%), Flipped Class (5%), GATE Questions 10 % Internal Examinations (40%)

REFERENCE:

1. Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2024). *Engineering circuit analysis*. McGraw Hill Education.
2. Boylestad, R. L. (2014). *Introductory circuit analysis*. Pearson Education India.
3. Alexander, C. K., & Sadiku, M. N. O. (2017). *Fundamentals of electric circuits*. McGraw Hill Education.
4. Kuo, F. F. (2012). *Network analysis and synthesis*. Wiley India.

E-Resources:

1. https://nptel.ac.in/courses/108102042
2. https://nptel.ac.in/courses/108105159
3. https://archive.nptel.ac.in/courses/108/104/108104139/
4. https://archive.nptel.ac.in/courses/117/106/117106108/
5. https://www.ee.iitm.ac.in/videolectures/doku.php?id=ee2015_2017nk:start

	CO Description	PO	PSO
CO1	Explain basic circuit laws, network theorems, and the behavior of circuit components	---	
CO2	Apply network analysis methods, such as mesh analysis and nodal analysis, for solving DC circuits.	PO1 (2) PO2 (3) PO4 (2)	PSO1(2) PSO2(3)
CO3	Analyze and evaluate the steady-state and transient behaviors of RL RC, RLC circuits and two-port networks.	PO2 (3) PO3 (2) PO4 (2)	PSO1(2) PSO2(3)

CS25C05	Data Structures using C++	L	T	P	C
		3	0	2	4

Course Objective:

- This course aims to provide an understanding of object-oriented programming principles using C++.

Data Abstraction & Overloading: Overview of C++, Structures, Class Scope and Accessing Class Members, Reference Variables, Initialization, Constructors, Destructors, Member Functions and Classes, Friend Function, Dynamic Memory Allocation, Static Class Members, Container Classes and Integrators, Proxy Classes, Overloading: Function overloading and Operator Overloading.

Practical:

1. Program to Implement Constructors and Destructors.
2. Program to implement Member Functions, Classes and Friend Functions.
3. Program to Implement Dynamic Memory Allocation and Overloading.

Inheritance & Polymorphism: Base Classes and Derived Classes, Protected Members, Casting Class pointers and Member Functions, Overriding, Public, Protected and Private Inheritance–Constructors and Destructors in derived Classes, Implicit Derived, Class Object to Base, Class Object Conversion, Composition Vs. Inheritance, Virtual functions, This Pointer, Abstract Base Classes and Concrete Classes, Virtual Destructors, Dynamic Binding.

Practical:

1. Program to Implement various inheritances.
2. Program to Implement virtual functions and dynamic binding.
3. Implementation of method overriding and operator overloading.

Linear Data Structures: Asymptotic Notations: Big-Oh, Omega and Theta, Best, Worst and Average case Analysis: Definition and an example, Arrays and its representations, Stacks and Queues, Linked lists, Linked list based implementation of Stacks and Queues, Evaluation of Expressions, Linked list based polynomial addition.

Practical:

1. Program to implement various operations on arrays and linked lists.
2. Program to implement various operations on stacks and queues using array and linked list.
3. Program to evaluate the infix expressions by converting into prefix and postfix expressions

Linear Data Structures: Asymptotic Notations: Big-Oh, Omega and Theta, Best, Worst and Average case Analysis: Definition and an example – Arrays and its representations, Stacks and Queues, linked lists, linked list based implementation of Stacks and Queues, Evaluation of Expressions, linked list based polynomial addition.

Practical:

1. Program to Implement Various Operations on Arrays and Linked Lists.

2. Program to Implement Various Operations on Stacks and Queues using Array and Linked List.
3. Program to Evaluate the Infix Expressions by converting into Prefix and Postfix Expressions.

Non-Linear Data Structures: Trees, Binary Trees, Binary tree representation and traversals, Threaded binary trees, Binary tree representation of trees, Application of trees: Set representation and Union, Find operations, Graph and its representations, Graph Traversals, Connected components. Standard template library.

Practical:

1. Program to Implement Binary Tree Traversal and Graph Traversal Algorithm.
2. Program to Implement the Single Source Shortest Path Algorithm and All Pair Shortest Path Algorithm.
3. Program to find the Minimal Spanning Tree for a Graph.

Searching, Sorting and Complexity Analysis: Insertion sort, Merge sort, Quicksort, Heapsort, Linear Search, Binary Search.

Practical:

1. Program to Implement Linear Search and Binary Search Algorithms.
2. Program to Implement Insertion Sort, Merge Sort, Quick Sort and Heap Sort Algorithms.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%), Practical (30%), Internal Examinations (40%)

References

1. Deitel, P. J., & Deitel, H. M. (2005). *C++ how to program*. Pearson Education.
2. Ellis Horowitz, E., Sahni, S., & Mehta, D. (2007). *Fundamentals of data structures in C++*. Universities Press Pvt Ltd.
3. Weiss, M. A. (2007). *Data structures and algorithm analysis in C++*. Addison-Wesley.
4. Trivedi, B. (2010). *Programming with ANSI C++: A step-by-step approach*. Oxford University Press.
5. Goodrich, M. T., Tamassia, R., & Mount, D. (2004). *Data structures and algorithms in C++*. Wiley.

E-Resources:

1. https://nptel.ac.in/courses/106/106/106106143/
2. https://www.tutorialspoint.com/data_structures_algorithms/index.htm

	CO Description	PO	PSO
CO1	Explain the concepts and applications of Data Structure in		

	various engineering applications		
CO2	Apply various Data Structure in real time	PO1(3)	PSO1(2)
CO3	Develop suitable and interrupt the data in real world applications	PO1(2) PO3(2)	PSO1(2)

UC25A03	Life Skills for Engineers – II	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart and cultivate analytical reasoning, innovative thinking, effective collaboration, and ethical leadership to prepare students for complex challenges in professional and personal environments.

Critical Thinking: Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Activities: Two-Brainstorm Method, “30 Circles” Challenge, “Desert Survival” Simulation, Lateral thinking riddles and puzzles, "What If?" Scenario Writing, Fast vs. Slow Thinking Game, Creativity Myth Busters

Problem Solving: Techniques, Six Thinking Hats, Mind Mapping, Forced Connections. Analytical Thinking, Numeric, symbolic, and graphic reasoning. Scientific temperament and Logical thinking.

Activities: Case study analysis, Escape Room challenge.

Leadership: Leadership Styles & Self-Assessment, Communication & Active Listening, Decision-Making & Responsibility, Teamwork & Delegation, Empathy, Integrity & Conflict Management, Vision, Motivation & Goal-Setting.

Activities: Crisis Leadership Simulation, Tower Challenge, Leadership Dilemmas Role-Play, Team Vision Board

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (20%), Flipped Class & Worksheets (10%), Practical (30%), Internal Examinations (40%)

References:

1. De Bono, E. (2017). *Six thinking hats*, Little, Brown Book Group.
2. Facione, P. A. (2015). *Critical thinking: What it is and why it counts*. Insight Assessment.
3. Kahneman, D. (2011). *Thinking, fast and slow*. Farrar, Straus and Giroux.
4. Whetten, D. A., & Cameron, K. S. (2016). *Developing management skills*. Pearson.

	Description of CO	PO	PSO
CO1	Explain the importance of leadership and management skills in life.	---	
CO2	Apply and demonstrate creative thinking techniques to generate innovative solutions.	PO7 (3)	PSO1(1) PSO2(1)
CO3	Exhibit effective collaboration and communication skills through teamwork, active listening, and conflict resolution strategies.	PO8 (2)	PSO3(3)
CO4	Integrate scientific temperament and logical reasoning into c problem solving in engineering and real-world contexts.	PO11 (2)	PSO2(1) PSO3(2)

EC25C03	Devices and Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objectives:

- To learn the characteristics of basic electronic devices such as diode, BJT, FET, SCR & UJT.
- To gain hands on experience in KVL, KCL, Thevenin, Norton, Super position, Reciprocity and Maximum Power Transfer theorem.
- To understand the working of RL, RC and RLC Circuits.

List of Experiments:

1. Characteristics of PN junction & Zener Diode.
2. Input and Output Characteristics of BJT.
3. Drain and Transfer Characteristics of FET.
4. Design clipper and clamper circuits.
5. VI Characteristics of SCR & UJT.
6. Demonstration of rectifier Circuits.
7. Verification of KVL & KCL.
8. Verification of Thevenin and Norton theorem.
9. Verification of super position theorem & Reciprocity theorem.
10. Verification of Maximum power transfer theorem.
11. Determination of resonance frequency of series & parallel circuits.
12. Transient Analysis of RL and RC circuits.

TOTAL: 60 PERIODS

	CO Description	PO	PSO
CO1	Perform experiments to evaluate and compare the characteristics of electronic components.	---	
CO2	Apply the concepts and demonstrate the different configuration of various electron devices.	PO1 (3)	PSO1(2)
CO3	Experimentally analyze and interpret of various theorems.	PO2 (2)	PSO1(3)
CO4	Perform experiments to evaluate the electric and magnetic circuits.	PO2 (2) PO4 (2)	PSO2(2) PSO3(1)

UC25A04	Physical Education - II	L	T	P	C
		0	0	4	1

Course Objectives:

- To impart knowledge on gymnastic exercises and pressing needs for upskilling in a particular game.

Basic gymnastics exercises: Warming up, Suitable exercise, Lead up games, Safety education, Movement education, Balanced Walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging, parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

Upskilling in any one of the athletics: Broad Jump, High Jump, Triple Jump, Relay Sprints, Javelin Throw, Discuss Throw, Shot Put, Short and Long-distance Running.

Advance skills in any one of the indoor/outdoor games, which has been opted by the student in the I semester.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Attendance (60%), Quiz (10%), Participation in Sports and Games (20%) and Viva Voce (10%)

References:

1. Singh, A. (2008). Essentials of physical education. Kalyani Publishers.
2. Kamlesh, M. L. (2006). Psychology in physical education and sport (3rd ed.). Metropolitan Book Co.
3. Mangal, S. K. (2009). *Psychology of sports performance*. Sports Publication.
4. Kandappan, K. (2004). *Foundations of physical education*. Friends Publications.

E-resources:

https://www.who.int/health-topics/physical-activity

	CO Description	PO	PSO
CO1	Understand and explain the importance of physical activity for mental and physical health.	---	
CO2	Apply safety principles and methods during sports activities.	PO1(3)	PSO3(1)
CO3	Develop teamwork, discipline, and leadership through sports and group activities and collaborate effectively.	PO8 (3)	PSO3(2)
CO4	Demonstrate the advanced technical skills and strategic understanding in the game of their interest.	PO11(1)	PSO3(2)

ME25C05	Re-Engineering for Innovation	L	T	P	C
		0	0	4	2

Course Objectives:

- To cultivate foundational skills in prototyping, and automation for development of prototypes with real-world applications.
- To provide a comprehensive, hands-on exposure to product development through reverse engineering concepts.

Bootcamp 1: Introduction to Product Development, Reverse Engineering, Overview of the product lifecycle, Hands-on disassembly of simple products, Practice of basic measurements and sketching, Introduction to CAD modeling of disassembled parts, Virtual assembly of parts.

Bootcamp 2: Embedded System Programming (Open-source platforms), Practice of interfacing sensors, reading data, automation in home, healthcare and agriculture.

Reverse Engineering: Sketch and prototype alternative designs, Group brainstorming sessions, Manufacture prototype parts using 3D printing and / or workshop tools, Assemble prototype product.

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

References:

1. Wang, W. (2010). Reverse engineering: Mechanisms, structures, systems & materials. CRC Press.
2. Margolis, M. (2020). Arduino cookbook: Recipes to begin, expand, and enhance your projects. O'Reilly Media.

E-Resources:

1. GrabCAD – https://grabcad.com/
2. GitHub – https://github.com/

	Description of CO	PO	PSO
CO1	Understand the product development lifecycle, including stages such as concept generation, design, prototyping, and testing.	---	
CO2	Apply reverse engineering techniques to analyze and document existing products.	PO1 (3) PO2 (2)	PSO1(2)
CO3	Collaborate in teams to fabricate prototypes using appropriate tools.	PO5 (2) PO8 (1) PO9 (1)	PSO3(3)
CO4	Engage in independent learning and continuously adapt to emerging technologies in product design	PO11(2)	PSO2(2)

	Description of CO	PO	PSO
			PSO3(2)

FOREIGN LANGUAGE^

UC25F01	Deutsch – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Deutsch language, including reading, writing systems, pronunciation, and speaking.

Basics & Introduction: German alphabet and pronunciation, Basic greetings and farewells, Introducing yourself and others (Ich heiße…, Wer bist du?), Numbers 1–100 and days of the week, Personal pronouns (ich, du, er, sie…), Sentence structure (SVO word order).

Activities: Alphabet spelling game, short skits, Use color-coded cards for SVO sentences.

Grammar Essentials & Everyday Vocabulary: Present tense of regular verbs (spielen, arbeiten, machen…), Common irregular verbs: sein (to be), haben (to have), gehen, kommen, Articles and gender (der, die, das; ein, eine), Simple questions and negation (nicht, kein), Describing people and things: adjectives and colors, Family, school, food, and common objects vocabulary.

Activities: Conjugate regular and irregular verbs, “Question Chain” game, Create a simple family tree.

Everyday Communication in German: Asking for and giving directions, Telling the time and talking about schedules, Ordering food and drinks at a café or restaurant, Talking about hobbies, weather, and daily routines, Listening to short conversations and responding appropriately, Introduction to German culture and formal/informal language use (du vs Sie).

Activities: Ordering food and drinks, Give directions, Formal / Informal greetings, Do’s and Don’ts.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%

References:

1. Funk, H., Kuhn, C., & Demme, S. (2015). *Menschen A1: Deutsch als Fremdsprache Kursbuch*. Hueber Verlag.

	CO Description	PO	PSO
CO1	Understand simple spoken Deutsch in everyday contexts.	---	
CO2	Communicate with widely used Deutsch words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Deutsch language.	PO11 (1)	PSO3(2)

UC25F02	Japanese – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Japanese language, including reading, writing systems, pronunciation, and speaking.

Writing Systems & Basic Communication: Introduction to Hiragana: vowels, basic characters, reading & writing, Introduction to Katakana: basic characters and usage, Basic greetings and farewells (こんにちは, おはようございます, さようなら), Introducing yourself (名前、出身、年齢), Basic sentence structure: Subject–Object–Verb, Numbers 1–100, days of the week, classroom expressions.

Activities: Flashcard games and writing drills, Self-introduction, Numbers & date-matching, Greeting expressions, Listening to audio.

Grammar & Everyday Vocabulary: Particles: は (wa), を (wo), の (no), へ (e), に (ni), Present tense verbs: です, ます-form conjugation (たべます、のみます), Negative forms: ではありません, ません, Describing people and objects using adjectives (い and な), Question formation: なに、どこ、だれ、いつ, Vocabulary for family, food, colors, and basic actions.

Activities: Verb conjugation drills, Guessing game, Picture description, “Shopping” with food vocab and counters

Conversation & Cultural Etiquette: Talking about routines and schedules (daily verbs, time expressions), Asking and giving simple directions (〜はどこですか？), Ordering food and making polite requests (〜をください、〜をおねがいします), Expressing likes and dislikes (すき・きらい), Listening to short conversations and identifying key phrases, Introduction to formal/informal speech and Japanese etiquette.

Activities: Skits and role-plays, daily schedule, beginner-level dialogue, Group discussion on etiquette.

Activities: Practice worksheets and flashcards for hiragana, Writing drills and reading simple katakana words, Dialogue practice for greetings and self-introduction, Sentence construction exercises with basic SOV structure, Particle usage exercises and short dialogues, Role-play scheduling, shopping, and telling time, Verb conjugation drills for common verbs, Descriptive sentence exercises using adjectives, Practice Q&A dialogues forming questions and negations, Kanji writing practice and quizzes for basic characters, Vocabulary tests and conversational practice on daily topics, Oral presentations and listening comprehension quizzes.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%

References:

1. Banno, E., Ikeda, Y., Ohno, Y., Shinagawa, C., & Tokashiki, K. (2011). Genki I: An integrated course in elementary Japanese. The Japan Times.
2. The Japan Foundation. (2017). Marugoto Japanese language and culture starter (A1) course book for communicative language activities. Goyal Publishers.

	CO Description	PO	PSO
CO1	Understand simple spoken Japanese in everyday contexts.	---	
CO2	Communicate with widely used Japanese words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Japanese language.	PO11 (1)	PSO3(2)

UC25F03	Korean – I	L	T	P	C
		1	0	2	1

Course Objectives:

- To impart fundamentals of the Korean language, including reading, writing systems, pronunciation, and speaking.

Fundamentals of Korean: Introduction to Hangul: consonants and vowels, Basic pronunciation and syllable formation, Common greetings and self-introductions, Numbers (Sino-Korean and Native Korean basics), Basic sentence structure (Subject-Object-Verb), Simple expressions (e.g., 감사합니다, 안녕하세요).

Activities: Writing and reading Hangul practice sheets, Pronunciation drills and audio repetition, Dialogue practice for greetings and self-introduction, Counting and number exercises.

Essential Grammar and Vocabulary: Particles (은/는, 이/가, 을/를) and usage, Basic verbs and present tense conjugation, Sentence patterns: affirmative, negative, interrogative, Common adjectives and descriptive sentences, Expressing possession and location, Asking simple questions (어디, 뭐, 누구).

Activities: Verb conjugation and sentence formation drills, Role-play conversations for shopping and daily routines, Descriptive writing and speaking exercises, Question and answer practice.

Everyday Korean Communication: Polite speech levels and honorifics introduction, Talking about time, dates, and schedules, Ordering food, shopping phrases, counting objects, Simple directions and transportation vocabulary, Listening practice with short dialogues, Cultural notes on etiquette and communication.

Activities: Role-play ordering at a restaurant or buying items, Listening comprehension exercises, Giving and asking for directions practice, Group conversations and presentations.

Weightage: Continuous Assessment: 100%

Assessment Methodology: Assignments (30%), Quiz (10%) and Internal Examinations 60%

References:

1. King, R., Yeon, J., & Brown, A. (2015). Elementary Korean. Tuttle Publishing.
2. Cho, Y., Lee, H., Schulz, C., Sohn, H.-M., & Sohn, S.-O. (2001). Integrated Korean: Beginning 1. University of Hawai'i Press.

	CO Description	PO	PSO
CO1	Understand simple spoken Korean in everyday contexts.	---	
CO2	Communicate with widely used Korean words effectively.	PO9 (2)	PSO3(2)
CO3	Develop the skills necessary for self-directed learning and continuous improvement in Korean language.	PO11 (1)	PSO3(2)

Semester III

MA25C11	Probability, Statistical and Random Processes	L	T	P	C
		3	1	0	4

Course Objective:

To provide a rigorous mathematical foundation in statistical analysis and probability theory required for industrial quality control, semiconductor manufacturing, signal processing, and modern communication systems. The course emphasizes "small sampling theory" and stochastic processes essential for electronics R&D.

Descriptive and Bivariate Statistics:. Univariate Measures: Mean, Median, Mode, Variance, and Standard Deviation, Relative Variation: Coefficient of Variation (CV) for comparing component stability., Bivariate Statistics: Covariance and the Correlation Coefficient (r), Linear Regression: Method of Least Squares for sensor calibration and trend analysis

Probability Foundations and Distributions

Probability Theory: Axioms, Conditional Probability, and Bayes' Theorem (Signal Detection).

Random Variables: Discrete (Binomial, Poisson for shot noise) and Continuous (Uniform, Exponential).

The Normal Distribution: Properties of Gaussian distributions, Central Limit Theorem, and Z-scores.

- **Multivariate Gaussian:** Joint PDFs, independence, and correlation in vector random variables.

Statistical Inference and Small Sampling

Sampling Distributions: Population vs. Sample; Degrees of Freedom.

Small Sample Tests: Student's t-distribution (One-sample and Two-sample tests).

Variance Analysis: Chi-square distribution and F-distribution for comparing production batches.

Estimation: Confidence Intervals for mean and variance of device parameters.

Hypothesis Testing and Error Metrics

Testing Framework: Null (H0) and Alternative (H1) Hypotheses.

Decision Errors: Type I error (Alpha), Type II error (Beta), and Power of a test.

p-values: Interpretation of p-values in industrial datasheets and medical electronics.

Parametric & Non-Parametric: ANOVA basics and Chi-square Goodness-of-Fit tests.

Stochastic Processes and Signal Noise

Random Processes: Concept of Stationarity (WSS) and Ergodicity.

Correlation Dynamics: Auto-correlation and Cross-correlation functions.

Frequency Domain: Power Spectral Density (PSD) and Wiener-Khinchin Theorem.

LTI Systems: Response of linear circuits to random noise; Introduction to the Kalman Filter.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Mandated Activities with weightage: Assignments, MATLAB Activities, Tutorials, Quiz.

Assessment Methodology: Assignments (20%), Solution to application-oriented problems using software (20%), Solving competitive examinations questions (20%), Internal Examinations (40%).

References:

1 Roy D Yates and David J Goodman, “Probability and Stochastic Processes”, Wiley India, New Delhi, 2021.

2 Douglas C Montgomery and George C Runger, “Applied Statistics and Probability for Engineers”, 7th edition, Wiley India, New Delhi, 2020.

3 Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes”, 1st Indian Reprint, Elsevier, 2014.

4 Saeed Ghahramani, “Fundamentals of Probability with Stochastic Processes”, 5th edition, CRC Press, USA, 2024.

5 Stark. H and Woods J.W, "Probability and Random Processes with Applications to Signal Processing", 3rd Edition, Pearson Education, Asia, 2001.

CO	Description of CO	PO	PSO
CO1	Understand the basic concepts of probability, random variables, standard probability distributions, and random processes.	-	-
CO2	Apply joint distributions, correlation, regression, and transformation of random variables for real-world data analysis.	PO1(3)	PSO1(1), PSO2(2)
CO3	Model and simulate random phenomena using stochastic processes and analyze their long-term behavior.	PO2(3), PO5(3)	PSO2(2), PSO3(1)
CO4	Analyze spectral properties of random signals, including autocorrelation, cross-correlation, and spectral density functions.	PO2(3)	PSO2(2)
CO5	Examine linear time-invariant systems with random inputs using transfer function analysis and stochastic system modeling.	PO2(3), PO5(3)	PSO2(2)

EC25C04	Signals and Systems	L	T	P	C
		3	1	0	4

Course Objective:

The course builds foundational skills for analyzing continuous and discrete-time signals, including their classification and properties, and explores key transforms (Fourier, Laplace, Z, DTFT).

Introduction to Signals and Systems:

Definition of Signals and Systems, Classification of Signals, Operations on signals, Singularity functions and related functions. Analogy between vectors and signals, orthogonal signal space, complete set of orthogonal functions, Parseval's relations.

Fourier Series Analysis:

Fourier series representation of continuous time periodic signals, Trigonometric and Exponential Fourier series, Properties of Fourier series.

Fourier Transform & Laplace Transform:

Fourier transform of aperiodic signals, standard signals and periodic signals, Properties of Fourier transforms. Hilbert transform and its properties. Laplace transforms, RoC, properties. Inverse Laplace transform.

Continuous-Time LTI Systems:

Continuous time Systems and its properties. Linear time invariant (LTI) system, Impulse response. Convolution. Analysis of LTI System using Laplace and Fourier transforms.

Sampling, Quantization & Discrete-Time Systems:

Sampling and reconstruction of band limited signals. Low pass and band pass sampling theorems. Aliasing. Anti-aliasing filter. Practical Sampling-aperture effect. Quantization. Discrete-time signals and systems. Discrete Fourier series, DTFT, Z-transform and its properties. Analysis of LTI systems using Z – transform.

Suggested activities: Quiz based on competitive examination problems (GATE, IES), Simulation Assignment.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1.Oppenheim, A. V., & Schafer, R. W. (2010). Discrete-time signal processing (3rd ed.). Pearson.

2.Haykin, S., & Van Veen, B. (2012). Signals and systems (2nd ed.). John Wiley & Sons.

3.Mitra, S. K. (2009). Digital signal processing: A computer-based approach (3rd ed.). Tata McGraw Hill.

4.Vaidyanathan, P.P.(2024). Signals, Systems ,and Signal Processing India, Cambridge University Press.

E-Resources:

1. NPTEL :: Electrical Engineering - Signals and Systems

2. https://onlinecourses.nptel.ac.in/noc21_ee28/preview

3. Principles of Signals and Systems - Course

CO	Description of CO	PO	PSO
CO1	Define and classify continuous-time and discrete-time signals, systems, and their fundamental properties.	-	-
CO2	Apply Fourier Series techniques to analyze periodic signals and interpret their frequency domain characteristics.	PO1 PO3	PSO1 (3) PSO2 (2)
CO3	Analyze Linear Time-Invariant (LTI) systems using convolution and transform methods.	PO2 PO3	PSO1 (3) PSO2 (2) PSO3 (2)
CO4	Develop and adapt solutions using sampling, quantization, and discrete-time signal processing techniques for real-world applications and continuous learning.	PO3, PO5	PSO2 (1) PSO3 (3)

VL25301	Digital Logic Design	L	T	P	C
		3	0	0	3

Course Objective:

This course provides a comprehensive understanding of Boolean algebra and logic minimization techniques to optimize digital circuit designs. It covers the design and analysis of combinational and sequential circuits, including arithmetic units, multiplexers, encoders, flip-flops, counters, and shift registers. Students will also explore memory technologies, programmable logic devices, and implement digital systems using both synchronous and asynchronous methods with VHDL.

Minimization Techniques and Logic Gates

Minimization Techniques: Boolean postulates and laws – De-Morgan‟s Theorem - Principle of Duality - Boolean expression - Minimization of Boolean expressions –– Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don‟t care conditions – Quine - Mc Cluskey method of minimization.

Logic Gates: AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NOR Implementations of Logic Functions using gates, NAND–NOR implementations – RTL, TTL, ECLand CMOS Logic and their characteristics – Tristate gates

Combinational Circuits

Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

Sequential Circuits

Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

Memory Devices

Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

Synchronous and Asynchronous Sequential Circuits

Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits
Asynchronous Sequential Circuits: Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VHDL/Verilog.

References:

1. M.MorrisMano,"DigitalDesign",4th Edition, Prentice Hall of India Pvt.Ltd.,2008/ Pearson Education (Singapore) Pvt.Ltd., New Delhi,2003.
2. JohnF.Wakerly,"Digital Design", Fourth Edition, Pearson/PHI,2008
3. John.M Yarbrough,"Digital Logic Applications and Design", Thomson Learning,
4. 2006.
5. Charles H.Roth."Fundamentals of LogicDesign",6th Edition, Thomson Learning,
6. 2013.
7. Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications",6th Edition,TMH, 2006.
8. ThomasL.Floyd,"DigitalFundamentals",10thEdition,Pearson Education Inc, 2011
9. Donald D.Givone,"Digital Principles and Design",TMH,2003.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

CO	Course Outcome	PO	PSO
CO1	Explain Boolean algebra laws, logic gates, and minimization techniques for digital circuits.	-	-
CO2	Apply knowledge of logic families and programmable logic devices (PROM, PLA, PAL) for implementing digital systems and memory elements.	PO1, PO2, PO3, PO5	PSO3 (3)
CO3	Design and analyze combinational circuits and sequential circuits	PO1, PO2, PO4	PSO2 (3)
CO4	Analyze asynchronous sequential circuits, identify hazards, and design race-free and hazard-free circuits.	PO1, PO2, PO3, PO4	PSO2 (3)
CO5	Evaluate the performance of digital circuits considering propagation delay, power consumption, and noise margins, and communicate results effectively while working in teams with ethical and societal awareness.	PO6, PO7, PO8, PO9, PO10, PO11	PSO3 (2)

VL25302	Analog Circuits	L	T	P	C
		3	0	0	3

Course Objective:

This course introduces the fundamentals of analog circuits using diodes, BJTs, and MOSFETs. It covers the design and analysis of biasing methods, amplifier configurations, multistage and differential amplifiers, feedback systems, and waveform generators. Students will design and simulate analog circuits using open-source tools to support theoretical understanding and practical skills.

Diode and Filter Circuits

Diode circuits - clipper, clamper, voltage doubler, voltage quadrupler, half-wave rectifier, centre-tapped full-wave rectifier, and bridge rectifier circuits, Power supply design. Regulators – Voltage regulator circuits using Zener diode. Passive filters – analysis of RC, RL, RLC filters.

Activity (Model Making):

Design and simulation of clipper and Bridge rectifier circuits using LTspice (open source)
Design and analysis of different passive filter circuits using LTspice.

Lab Activity (Breadboard):

(i) Design of a 5V regulated DC power supply.
(ii) Design and analyze the frequency response of basic passive filter circuits.

BJT and MOSFET Circuits

BJT Circuits - Load-line analysis, different biasing techniques of BJT, bias stabilization, and early effect, RC-coupled and transformer-coupled multistage amplifiers, and current mirror circuits. MOSFET circuits – Biasing by fixing V_{GS}, biasing by fixing V_G, and connecting a resistor in the source, Biasing using a drain-to-gate feedback resistor, and biasing using a current source. Analysis and design of common source, common drain, common gate amplifier configurations.

Activity (Flipped classroom and Quiz):

Flipped classroom is followed by a quiz where students learn amplifier circuits through pre-class study and apply concepts in solving and analyzing problems in class.

Lab Activity (Breadboard):

(i) Study of different BJT biasing techniques and analyze their effect on stability.
(ii) Design and test of Common-Source amplifier.

Frequency Response of Amplifiers

Frequency response of amplifiers – Low frequency response of BJT and FET amplifiers, lower cut off frequency - hybrid π equivalent circuit of BJT - high frequency response of BJT amplifiers –upper cut off frequency – transition frequency - Miller effect, high frequency response of FET amplifiers. Wide band amplifiers - Wide banding techniques – CC–CE /CD-CS cascade, cascade amplifier, Darlington pair.

Activity (Flipped classroom and Quiz):

Flipped classroom followed by a quiz where students learn differential amplifiers through pre-class study and apply concepts in solving and analyzing problems in class.

Lab Activity (Breadboard):

(i) Study of frequency response of single-stage BJT and FET amplifiers.
(ii) Design and analysis of Darlington amplifier circuits.

Feedback Amplifiers and Waveform Generators

Feedback and stability- negative and positive feedback in amplifiers, analysis of four feedback topologies, loop gain. Oscillators - Barkhausen criterion, effect of feedback on amplifier poles, Bode plots, gain and phase margins; positive feedback and sinusoidal oscillators using BJT - Wein bridge oscillator, RC phase shift oscillator, Hartley and Colpitts oscillators. Multivibrators using BJT – astable, monostable, and bistable circuits.

Activity (Model Making & Seminar Presentation):

Design and analysis of a high-frequency Hartley oscillator using LTspice. And a technical seminar presentation on the design methodology of multivibrator circuits.

Lab Activity (Breadboard):

(i) Study of Feedback Amplifier Topologies and Stability Using Bode Plot.

(ii) Design and analysis of multivibrators (astable, monostable, bistable) using BJT.

Power Amplifiers

9Power amplifiers –Analysis of Class A, B, AB, C, D & S power amplifiers, Conversion efficiency and relative performance, Total Harmonic Distortion (THD), Relationship Between Total Power and THD, Heat sinks.

Activity (Model Making):

Design and simulation of Class B/AB amplifier using LTspice.

Lab Activity (Breadboard):

(i) Design and Efficiency Analysis of Class B Power Amplifier.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1. Sedra, Adel S., and Kenneth C. Smith, Microelectronic Circuits, 8th Edition, Oxford University Press, 2020.
2. Donald A. Neamen, Microelectronics: Circuit Analysis and Design, 5th Edition, McGraw-Hill Education, 2021.
3. Behzad Razavi, Fundamentals of Microelectronics, 2nd Edition, Wiley, 2016.
4. David A. Bell, Electronic Devices and Circuits, 5th Edition, Oxford University Press, 2008.
5. Electronic Devices and Circuit Theory. By Robert Boylestad and Louis Nashelsky, Pearson Education, 2021.

E-Resources

1. https://nptel.ac.in/courses/108106084
2. https://onlinecourses.nptel.ac.in/noc21_ee07/preview
3. https://archive.nptel.ac.in/courses/108/106/108106084/
4. https://nptel.ac.in/courses/108106188
5. https://ocw.mit.edu/courses/6-101-introductory-analog-electronics-laboratory-spring-2007/
6. https://www.my-mooc.com/en/mooc/circuits-electronics-1-basic-circuit-mitx-6-002-1x-0/
7. http://www.pyroelectro.com/edu/analog/

CO	Description of CO	PO	PSO
CO1	Define, understand, and explain concepts related to diode, BJT, and MOS transistor circuits.	-	-
CO2	Apply the knowledge of network theorems and device models to solve given analog electronic circuits.	. PO1 (2), PO2 (3), PO3 (2), PO4 (1)	PSO1 (2)
CO3	Design of analog electronic circuits for a given specification and its analysis to compute required parameters.	PO2 (2), PO3 (3), PO4 (2), PO5 (2), PO12 (1)	PSO2 (3)
CO4	Simulate linear circuits using appropriate EDA tools and implement analog electronics circuits using breadboard.	PO3 (3), PO5 (3), PO9 (2), PO11 (2)	PSO3 (3)

CS25301	Python Programming	L	T	P	C
		2	0	2	3

Course Objective:

Develop algorithmic problem-solving skills using Python by applying conditionals, loops, functions, data structures (lists, tuples, and dictionaries), and file input/output operations.

Data Types, Expressions, Statements

Python interpreter and interactive mode, debugging; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments

Control Flow, Functions, Strings

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional(if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays.

Lists, Tuples, Dictionaries

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension.

Files, Modules, Packages

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages.

Practical exercises:

Note: The examples suggested in each experiment are only indicative. The lab instructor is expected to design other problems on similar lines. The Examination shall not be restricted to the sample experiments listed here.

1. Write a python code to generate and plot standard continuous-time and discrete-time signals such as unit step, ramp, impulse, sinusoid, exponential signals. Also, apply signal operations such as shifting, folding and scaling on these signals.
2. Write a python code to apply algebraic operations to multiple signals. Also, implement time reversal and shifting on these signals.
3. Write a python code to compute and visualize Fourier Series of periodic waveforms.
4. Write a python code to apply Fast Fourier transform (FFT) for analyzing the spectrum of time-domain signals.
5. Write a python code to compute Laplace transform of continuous time elementary functions. Also, apply inverse Laplace transform to find time-domain response.
6. Write a python code to compute the output of LTI system using convolution.
7. Write a python code to sample a signal at different rates, above and below Nyquist

rate and to demonstrate the aliasing effect. Also, reconstruct the original signal using interpolation techniques.

8. Write a python code to apply Discrete Fourier transform (DFT) to discrete signals and to analyze the DFT spectrum.
9. Write a python code to compute Z transform of discrete time signals and hence to simulate discrete time systems.

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Project (15%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)

References:

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O"Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.
1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. S. Esakkirajan, T. Veerakumar, B. N. Subudhi, Digital Signal Processing: Illustration Using Python. Springer: Singapore, 2024.

CO	Description of CO	PO	PSO
CO1	Understand Python basics including data types, expressions, statements, and control flow constructs for problem solving.	-	-
CO2	Apply functions, recursion, and string operations to develop modular Python programs.	PO1(3) PO2(3) PO3(2) PO5(2)	PSO1(3) PSO2(2)
CO3	Use Python data structures such as lists, tuples, and dictionaries for efficient data manipulation and processing.	PO2(3) PO3(3) PO4(2) PO5(3) PO9(2)	PSO2(2) PSO3(3)
CO4	Implement file handling, exception handling, modules, and packages for building structured Python applications.	PO1(2) PO2(3) PO5(3) PO9(1) PO11(1)	PSO1(2) PSO2(2)
CO5	Apply Python programming techniques to solve engineering problems involving signal processing, FFT, sampling, and system simulation.	PO2(3) PO3(3) PO4(3)	PSO2(3) PSO3(3)

VL25303	Digital Logic Design Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

This course aims to build a strong foundation in understanding and applying logic gates for digital circuit design. It emphasizes the design of advanced combinational and sequential logic circuits, leading to the development of practical sequential applications. Additionally, students will gain hands-on experience in Verilog HDL programming and enhance their problem-solving abilities through project-based learning.

Implementation of a binary adder and subtractor using logic gates.

1. Design and implementation of odd/even parity generator and checker using logic gates
2. Design and implementation of code converters using logic gates.
    - Binary to gray
    - Binary to BCD
3. Design and implementation of a 2-bit magnitude comparator using logic gates.
4. Design and implementation of Multiplexer& Demultiplexer using logic gates
5. Design and implementation of encoder & decoder using logic gates
6. Implementation of the given gates and simple Boolean functions using Multiplexers and Decoders.
7. Construct a NAND and NOR SR Latch using logic gates.
8. Construct a D and JK flip-flop using logic gates.
9. Conversion of one flip-flop into another flip-flop.
10. Design a Prescaler circuit using flip-flops
11. Design and implementation of Shift register (SISO, SIPO,PIPO) using flip-flops
12. Design and implementation of up and down counters using flip-flops

Programming using Verilog VHDL:

a. Multiplexers & Demultiplexers
b. Encoders and Decoders
c. Flip-flops (SR, JK, T, D)

Project-Based Activity:

- Design and build a digital system using combinational and sequential circuits (e.g., a digital stopwatch, a simple calculator, or a traffic light controller, etc.)
- Draw the block diagram of a simple RISC-V CPU. Select and design one of the blocks such as the Program Counter, Memory Address Register, RAM, or ALU etc..
- Design of rolling display, Design of real time clock.

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

CO	Description of CO	PO	PSO
CO1	Design and implement combinational logic circuits such as adders, subtractors, comparators, multiplexers, encoders, decoders, and code converters using logic gates.	-	-
CO2	Design and implement sequential logic circuits including latches, flip-flops, counters, shift registers, and their conversions using logic gates.	PO1(3) PO2(3) PO3(3) PO4(2) PO5(2)	PSO2(2) PSO3(3)
CO3	Develop and simulate digital circuits using Verilog HDL for combinational and sequential modules such as MUX, DECODER, and flip-flops.	PO1(2) PO2(3) PO3(3) PO5(3)	PSO2(3) PSO3(3)
CO4	Design and implement project-based digital systems such as counters, clocks, RISC-V components, and real-time applications using combinational and sequential logic.	PO3(3) PO4(3) PO5(3) PO9(3)	PSO2(2) PSO3(3)

VL25304	Analog Circuits Laboratory	L	T	P	C
		0	0	4	2

To analyze the frequency response and bandwidth of transistor amplifiers and oscillator circuits, and to understand the characteristics of differential, feedback, and power amplifiers and to simulate and verify transistor biasing circuits along with amplifier and oscillator designs.

List of Experiments

- Design and analysis of rectifiers (HWR, FWR, Bridge) with filters.
- Design of Zener diode voltage regulator and power supply.
- Design and analysis of BJT and MOSFET biasing circuits.
- Frequency response analysis of Common Emitter/Common Source amplifiers.
- Frequency response analysis of Common Base/Common Gate amplifiers.
- Frequency response analysis of Common Collector/Common drain amplifiers.
- Design and Analysis of two-stage negative BJT/MOSFET Feedback amplifiers using anyone of the feedback topologies
- Design and simulation of RC phase shift and Wien bridge oscillators.
- Design and analysis of Hartley and Colpitts Oscillators
- Analysis of Class A and Class B power amplifiers with efficiency calculation

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

CO	Description of CO	PO	PSO
CO1	Apply the knowledge of analog electronics to perform and analyze experiments on amplifiers and oscillators, including CE, CB, CC, MOSFET amplifiers, and feedback circuits.	-	-
CO2	Investigate the performance of differential amplifiers and feedback amplifiers by measuring parameters such as gain, bandwidth, CMRR, and input/output impedance	PO2 (3), PO4 (3)	PSO1 (3)
CO3	Design, implement, and analyze oscillator circuits including RC Phase Shift, Wien Bridge, Hartley, and Colpitts oscillators using experimental and simulation techniques	PO3 (3), PO5 (2)	PSO2 (2)
CO4	Work effectively in teams to design, simulate, and present analog electronic circuits, demonstrating communication, ethical practices, and project management skills	PO9 (3), PO10 (3), PO11 (2), PO8 (1	PSO1 (3)

EN25C03	English Communication Skills Laboratory– I	L	T	P	C
		0	0	2	1

Course Objectives:

The objectives of the course are to foster students' confidence and fluency in professional and social communication and to bridge the gap between academic English and industry expectations.

List of Activities

A. Elements of Effective Speaking and Listening

(i) Sharing life experience/ turning point in their life – SATORI
(ii) Situational Conversation – eg. Talking to a Senior about Internship Tips
(iii) Welcoming a Guest Speaker at a Seminar
(iv) Pictography to represent data using images or symbols
(v) B2-C1 Listening exercises include lectures, interviews, and discussions.

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication
(ii) Mini-Presentations: Topics like "My Dream Project," "Engineering in 2050,"3-minute technical pitches with logical flow
(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

(i) Introduction to Group Discussions - Key skills for effective participation
(ii) Phases in a GD and Conversational Phrases in GD.
(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries
(ii) Social Media Optimisation
(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

(i) Listening to podcast (motivational, career oriented, success stories)
(ii) Podcast Preparation – Purpose – Topic – Structure – Recording Tips - Publication of the Podcast

F. Mock Interviews and Communication Strategies:

(i) Listening – Job interview
(ii) Speaking – Mock interviews

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%.

Internal Assessment: 1. Listening (20 marks)
2. Video Resume (20 marks)
3. Creating a Podcast (30 marks)
4. Mock interview (30 marks)

End Semester Assessment: 1. Presentation with PPT (50 marks)
2. Group Discussion (50 marks)

References:

1. Floyd Kory, "Interpersonal Communication", McGraw Hill Publication, 2023.
2. Bharadwaj Apoorva, "Leadership Communication Skills for Intercultural Management: Strategies for Effective Intercultural Management (Contemporary Themes in Business and

Management)", Routledge India; 1st edition, 2024.

3. Helen Spencer-Oatey and DomnaLazidou**, "**Making Working Relationships Work: The TRIPS Toolkit for Handling Relationship Challenges and Promoting Rapport",Castledown Publishers,2023.
4. Presentations - Cambridge
5. Speaking Extra -
6. Listening Extra – Miles Craven by Cambridge University Press
7. CVs, Resumes, and LinkedIn: A Guide to Professional English – Springer International Publishing

E-resources:

1. Train your mind to perform under pressure- Simon Sinek https://curiosity.com/videos/simon-sinek-on-training-your-mind-to-perform-under-pressure-capture-your-flag/
2. Brilliant way one CEO rallied his team in the middle of layoffs https://www.inc.com/video/simon-sinek-explains-why-you-should-put-people-before-numbers.html
3. Will Smith's Top Ten rules for success https://www.youtube.com/watch?v=bBsT9omTeh0

	Description of CO	**PO**	**PSO1**
CO1	Communicate effectively in everyday professional situations with confidence	-	-
CO2	Deliver well-organised and effective presentations.	PO9(3)	PSO1(1) PSO3(2)
CO3	Participate in group discussions and express ideas clearly and confidently.	PO8(2) PO9(3)	PSO3(2)
CO4	Create professional video resumes and participate in interviews effectively.	PO9(2)	PSO3(3)
CO5	Create, record and publish motivational podcasts.	PO9(2) PO11(1)	PSO2(2) PSO3(3)

Semester – IV

VL25401	Graph Theory for VLSI Engineers	L	T	P	C
		3	0	0	3

Course Objective:

This course aims to equip VLSI design engineers with a strong foundation in graph theory concepts and algorithms relevant to various stages of VLSI design, including logic synthesis, physical design and design verification.

Fundamentals of Graph Theory and Graph Representations in VLSI

Introduction to Graphs: Definitions: Vertices, Edges, Directed/Undirected Graphs, Weighted Graphs, Graph Representations- Adjacency Matrix, Adjacency List, Incidence Matrix, Paths, Cycles, Connectivity, Trees, Forests, Graph Isomorphism.

Graph fundamentals: Graph categories- Hypergraph, Graphs with parallel edges, Graphs without parallel edges, Weighted graph, Directed graph- Inter-graph relationships - Graph exploration - Bipartite graph - Directed acyclic graph – Tree - Common problems in graph theory – Pathfinding, Spanning tree, Graph coloring, Topological sorting

Graphs in VLSI circuits and systems

Graphs as a VLSI abstraction tool- Register transfer level, Register allocation, Task scheduling, Synchronization, Gate layer - Ordered binary decision diagram, And-inverter graph, Circuit layer - Laplacian matrix of a circuit graph, Physicallayer -Partitioning,

Synchronization in VLSI

Graph-based timing analysis -Timing constraints in synchronous systems, Clock skew scheduling – Robustness, Performance, Power, Clock tree synthesis - Clock tree topology, Clock tree embedding, Method of means and medians, Deferred merge embedding, Elmore delay, Bounded skew tree, Useful skew tree

Circuit analysis

Modified nodal analysis, Iterative numerical methods - Domain decomposition, H-matrix, Multigrid methods, Non-MNA techniques- Scattering parameters, Random walks, Lattice graph

Graph Theory in Logic Synthesis, Verification, and Emerging Trends

Graphs in Logic Synthesis- AND-Inverter Graphs (AIGs) for representing combinational logic. Technology Mapping-Graph covering problem, tree covering algorithms, Functional decomposition and factorization.

Verification Techniques - Critical Path Method (CPM) on DAGs for static timing analysis (STA), Longest path algorithms for slack calculation, Binary Decision Diagrams (BDDs): Graph representation of Boolean functions for equivalence checking and model checking, Satisfiability (SAT) Solvers: Graph-based formulations for design verification.

Emerging Trends - Graph Neural Networks (GNNs) in vlsi design, Quantum Circuit Graphs, Open-Source EDA Tools (ABC, Yosys)

References:

1.Logic Synthesis and Verification by Gary D. Hachtel, Fabio Somenzi

2. Graph Theory with Applications to Engineering & Computer Science by Deo Narsingh

3. Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology by Lavagno, Luciano; Markov, Igor L.; Martin, Grant and Scheffer, Louis K
4.https://yosyshq.net/yosys/
5. https://people.eecs.berkeley.edu/~alanmi/abc/
1. "Graph Theory" by Reinhard Diestel
2. "Introduction to Algorithms" by Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein (CLRS)
1.Graphs in VLSI by Rassul Bairamkulov, Eby G. Friedman · 2022
2.Physical Design Automation of VLSI Systems by Sadiq M. Sait and Habib Youssef
3.Algorithms for VLSI Design Automation by Sabih H. Gerez

CO	Description of CO	PO	PSO
CO1	Understand fundamentals of graph theory and graph representations used in VLSI systems.	-	-
CO2	Model VLSI circuits using graph structures such as DAGs, AIGs, BDDs, and hypergraphs.	PO2 (3)	PSO1(3) PSO2(2)
CO3	Apply graph algorithms for VLSI design tasks such as partitioning, placement, routing, and scheduling and graph-based techniques in logic synthesis, verification, and emerging EDA trends.	PO1(3) PO3(3) PO5(3)	PSO2(2) PSO3(3)
CO4	Analyze timing, synchronization, and clock tree structures using graph-based methods in VLSI systems.	PO2(3)	PSO2(2) PSO3(3)

VL25402	Digital VLSI Design	L	T	P	C
		3	0	0	3

Course objective:

The course aims to impart foundational knowledge on IC design abstraction levels, CMOS fabrication processes, and ASIC/FPGA design flows. It enables students to analyze the behavior of MOS transistors, explore various CMOS logic styles, and apply low-power design techniques. Additionally, the course develops competency in memory design, physical layout, and the implementation of arithmetic sub-systems in VLSI, equipping students with essential skills for advanced integrated circuit design.

IC Design Flow Overview and Manufacturing of CMOS Integrated Circuits

Design abstraction levels in digital circuits - Issues in Digital Integrated Circuit Design - Quality Metrics of a Digital Design - ASIC Design Flow: Full Custom and Semi-custom Approach – FPGA Design flow – Difference between ASIC and FPGA - Silicon Semiconductor technology: The Silicon Wafer - Photolithography - Some Recurring Process Steps - Simplified CMOS Process Flow

Design Flow Explorer Activity:

Develop a Comparative Flowchart of Full Custom, Semi-Custom, and FPGA design methodologies, including EDA Tool Mapping for each step.

Fundamentals of MOS Transistors & CMOS Inverter Characteristics

Basic MOS transistors: Symbols, Enhancement mode - Depletion mode transistor operation - Regions of operation – Non-Ideal I-V Characteristics - CMOS inverter: DC Characteristics - Noise Margin – Switching Characteristics – Transistor Sizing - Static & Dynamic Power Dissipation

Seminar: Summary of MOSFET Operation and Characteristics - Understanding of Static and Dynamic Power Dissipation

Logic Styles and Low Power Designs

Static CMOS Design - Pseudo-nMOS Logic- Cascode Voltage Switch Logic (CVSL) - Pass-Transistor Logic – Transmission Gate - Dynamic CMOS Design: Basic Principles - Domino logic - Power Logic Design Techniques:Reduction of Voltage Swing – Reduction of Switching Activity - Power Management Basic Techniques: Clock Gating - Power Gating

CMOS Logic Styles – A Practical Design Project:

Use any EDA tools to compare Area, Power, and Delay of any Gates or any combinational circuits implemented using Static CMOS, Pass Transistor, Dynamic, Domino, and CVSL logic. Suggest which logic style suits different applications based on the results.

Semiconductor Memories and Physical Design

Conventional CMOS Latches – CMOS D Flip Flop – SDFF – TSPC Flip Flop – 6T SRAM –SRAM Array - 1T DRAM – CAM

Physical Design: Stick Diagrams - Layout Design Rules – Layout Design of Digital Logic.

Draw Your Chip Activity:

Draw the Schematic, Stick Diagrams, and Layout of basic CMOS Logic Gates (or) Universal logic gates or Memory Element. Use color sketches on an A3 sheet and submit them as a report.

VLSI Sub-System Design

Adders: Ripple Carry Adder - Carry Look Ahead Adder - Carry Skip Adder - Carry Select Adder - Multipliers: Unsigned Array Multiplier – Two's Complement Signed Multiplier- Booth Encoding Multiplier

VLSI Arithmetic Activity:

Consider any two (A & B) 8-bit data,

1. Add A and B using:Ripple Carry Adder and Carry Select Adderby hand.
2. Multiply A and B using the Array Multiplier and Booth Encoding method by hand.

Submit a report with step-by-step solutions, the Architecture required for solving the problem, and a brief discussion on trade-offs in terms of delay, area, and power.

References:

1. Neil.H.E Weste David Harris CMOS VLSI Design: A Circuits and Systems Perspective, 4th edition, Pearson Addison Wesley, 2015.
2. Rabaey, Chandrakasan and Nikolic, Digital Integrated Circuit: A design Perspective, PHI, Second Edition ,2016.
3. John P.Uyemura, Introduction to VLSI circuits and systems, John Wiley, 2016.
4. Kamran Eshraghian, Douglas A. Pucknell, Essentials of VLSI Circuits and Systems Prentice Hall of India, 2015.
5. Kang and Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McGraw Hill, 2014
6. https://onlinecourses.nptel.ac.in/noc21_ee09/preview

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

CO	Course Outcome	PO	PSO
CO1	Understand IC design flow and CMOS fabrication process.	-	-
CO2	Design MOS circuits and analyze the factors influencing the operation of CMOS transistors	PO1 (3) PO2 (2)	PSO1 (3)
CO3	Design a semiconductor memory and the physical layout of the digital logic	PO1 (3) PO2 (2) PO3 (3)	PSO2 (3)
CO4	Design and optimize arithmetic subsystems such as adders and multipliers using VLSI techniques	PO1 (2) PO2 (3) PO3 (3)	PSO2 (3)

CO5	Analyze the speed, power, and area trade-offs of different circuit families for combinational logic and sequential logic	PO1 (2) PO2 (3) PO3 (2) PO4 (2) PO5 (3)	PSO3 (3)

VL25403	Introduction to Standards in VLSI Design	L	T	P	C
		1	0	0	1

Course Objective:

To introduce the principles of standardization, conformity assessment, and regulatory frameworks relevant to VLSI, electronics, and information technology products at national and international levels.

Overview Of Standards

Basic concepts of standardization; Purpose of Standardization, marking and certification of articles and processes; Importance of standards to industry, policy makers, trade, sustainability and innovation. Objectives, roles and functions of BIS, Bureau of Indian Standards Act, ISO/IEC Directives; WTO Good Practices for Standardization. Important Indian and International Standards.

National, International Standards & Technical Regulations in India

- Objectives, Roles and Functions of BIS, Bureau of Indian Standards Act
- Important Indian and International Standards
- ISO/IEC , IAF and ILAC – Their Role in Conformity Assessment
- Product Standards , Codes of Practice, Testing Standards, National Codes on Electricity and Lighting Management Systems Standards – Difference and industry preferences
- Marking and Certification of articles - ISI Mark and management systems
- Regulations on Compulsory Registration Scheme for Electronics & IT Goods - Electronics and Information Technology Goods (Requirement of Compulsory Registration) Order, 2021
- BIS Conformity Assessment Regulation 2018

References

1. Bureau of Indian Standards (BIS), *Bureau of Indian Standards Act, 2016*, 1st Edition, BIS Publications, New Delhi, India, 2016.
2. Bureau of Indian Standards (BIS), *BIS Conformity Assessment Regulations, 2018*, 1st Edition, BIS Publications, New Delhi, India, 2018.
3. International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), *ISO/IEC Directives, Part 1: Procedures for the Technical Work*, 18th Edition, ISO, Geneva, Switzerland, 2024.
4. International Organization for Standardization (ISO) and International Electrotechnical Commission (IEC), *ISO/IEC Directives, Part 2: Principles and Rules for the Structure and Drafting of ISO and IEC Documents*, 9th Edition, ISO, Geneva, Switzerland, 2021.
5. S. Dalela and Sourabh, *Engineering Quality and Standardization*, 4th Edition, S. Chand Publishing, New Delhi, India, 2017.
6. M. Mahajan, *Industrial Engineering and Production Management*, 3rd Edition, Dhanpat Rai Publications, New Delhi, India, 2019. (Relevant chapters on quality systems, standardization, and certification.)

- **Ministry of Electronics and Information Technology (MeitY)**, *Electronics and Information Technology Goods (Requirements for Compulsory Registration) Order, 2021*, Government of India, New Delhi, 2021.

EC25C15	Linear Integrated Circuits	L	T	P	C
		3	0	0	3

Course Objective:

- This course focuses on designing high-performance linear integrated circuits and intelligent analogfront-ends for industrial automation and smart products.
- Students will gain hands-on expertise in simulating and prototyping analog modules integrated into Industry 4.0 and cyber-physical systems.

Basics of Operational Amplifiers

Current mirror and current sources, Current sources as active loads, Voltage sources, Voltage References, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal Operational Amplifier - General operational amplifier stages -and internal circuit diagrams of IC 741, DC and AC performance characteristics, slew rate, Open and closed loop configurations – MOSFET Operational Amplifiers – LF155 and TL082.

Applications of Operational Amplifiers

Sign Changer, Scale Changer, Phase Shift Circuits, Voltage Follower, V-to-I and I-to-V converters, adder, subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic amplifier, Comparators, Schmitt trigger, Precision rectifier, peak detector, clipper and clamper, Low-pass, high-pass and band-pass Butterworth filters.

Analog Multiplier and PLL

Analog Multiplier using Emitter Coupled Transistor Pair - Gilbert Multiplier cell – Variable transconductance technique, analog multiplier ICs and their applications, Operation of the basic PLL, Closed loop analysis, Voltage controlled oscillator, Monolithic PLL IC 565, application of PLL for AM detection, FM detection, FSK modulation and demodulation and Frequency synthesizing and clock synchronization

Analog to Digital and Digital to Analog Converters

Analog and Digital Data Conversions, D/A converter – specifications - weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications - Flash type - Successive Approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion - Over-sampling A/D Converters, Sigma – Delta converters.

Waveform Generators and Special Function ICS

Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low Drop – Out(LDO) Regulators - Switched capacitor filter IC MF10, Frequency to Voltage and Voltage to Frequency converters, Audio Power

amplifier, Video Amplifier, Isolation Amplifier, Opto- couplers and fibre optic IC
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.
Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).
Recommended Activities: Competitive Problem-Solving (GATE & Beyond), Hands-On Simulation & Hardware, Collaborative Assignments & Research & Modern Trends.
References: 1. D.Roy Choudhry, Shail Jain, “Linear Integrated Circuits”, New Age International Pvt. Ltd., 2018, Fifth Edition. 2. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, 4th Edition, Tata Mc Graw-Hill, 2016 3. Ramakant A. Gayakwad, “OP-AMP and Linear ICs”, 4th Edition, Prentice Hall / Pearson Education, 2015 4. Robert F.Coughlin, Frederick F.Driscoll, “Operational Amplifiers and Linear Integrated Circuits”, Sixth Edition, PHI, 2001. **5.** S.Salivahanan & V.S. Kanchana Bhaskaran, “Linear Integrated Circuits”, TMH,2nd Edition, 4th Reprint, 2016.
E**-Resources”** 1.https://www.ti.com/analog 2.https://nptel.ac.in/courses/108107029 3.https://ocw.mit.edu/courses/6-002-circuits-and-electronics-spring-2007/ 4.coursera.org/learn/analog-integrated-circuit 5.https://ez.analog.com/

CO	CO Description	PO	PSO
CO1	Explain advanced operational amplifier theory, parameters, architectures, and analog front-end design for sensor interfaces.	-	-
CO2	Analyze and design linear IC applications such as filters, amplifiers, and signal conditioning circuits for smart industrial systems.	PO2, PO4	PSO2 (3)
CO3	Analyze and design mixed-signal systems including ADCs, DACs, oscillators, and real-time analog-digital interfaces.	PO2, PO4	PSO2 (3)
CO4	Develop system-level analog solutions using timers, PLLs, and LIC integration inIndustry 4.0 and cyber-physical systems.	PO3 PO5, PO11	PSO3 (3)

EC25C06	Electromagnetic Fields and Transmission Lines	L	T	P	C
		3	0	0	3

Course objective:

Covers static electric and magnetic field laws, Maxwell's equations, and electromagnetic wave propagation across media, transmission lines, and waveguides.

Coordinate Systems

Fundamentals of scalars and vectors, Coordinate systems.

Electrostatics:

Coulomb's Law, Gauss's Law, Electric Scalar Potential, Electric Boundary Conditions, Capacitance, Electrostatic Potential Energy.

Magnetostatic:

Ampere Circuital law- Biot–Savart Law, Magnetic Forces and Torques, Maxwell's Magnetostatic Equations, Vector Magnetic Potential, Magnetic Boundary Conditions, Inductance, Magnetic Energy.

Maxwell's equations:

Equation of continuity, Maxwell's equations for time varying fields, boundary conditions. Wave equation, EM waves in conducting medium and dielectric medium , Uniform plane wave equation.

Transmission Lines

Transmission Lines, types, two-wire line-Equivalent circuit , characteristic impedance, propagation constant, input impedance, VSWR, reflection and transmission coefficients, return loss, quarter-wave transformer -impedance matching using smith chart.

Waveguide

Parallel plate, TEM-TM-TE-Cut off frequency, rectangular waveguide, parameters related to waveguides.

Suggested activities: GATE Questions, Assignments, and Project-based learning

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.

Assessment Methodology: Assignment (20%), Software activity (20%), Quiz (20%), Internal Examinations (40%).

References:

1. D.K. Cheng, Field and wave electromagnetics, 2nd ed., Pearson (India), 2002.
2. M.N.O.Sadiku and S.V. Kulkarni, Principles of electromagnetics, 6th ed., Oxford(Asian Edition), 2015.
3. Edward C. Jordan & Keith G. Balmain,Electromagnetic waves and Radiating Systems, Second Edition, Prentice-Hall Electrical Engineering Series, 2012.

4. W.H. Hayt and J.A. Buck, Engineering electromagnetics, 7th ed., McGraw-Hill (India), 2006 3. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011.

5. B.M. Notaros, Electromagnetics, Pearson: New Jersey, 2011.

E-Resources:

1.https://onlinecourses.nptel.ac.in/noc21_ee83/
2.https://www.feynmanlectures.caltech.edu/I_toc.html
3.http://www.digimat.in/nptel/courses/video/117101056/L10.html

CO	Description of CO	PO	PSO
CO1	Define and explain the fundamental concepts of electrostatics and magnetostatics including Coulomb's law, Gauss's law, Ampere's law, and Biot–Savart law.	-	-
CO2	Apply Maxwell's equations and boundary conditions to analyze electric and magnetic fields in static and time-varying conditions.	PO1 PO3	PSO1 (3), PSO2 (2)
CO3	Analyze electromagnetic wave propagation in conducting and dielectric media using wave equations and uniform plane wave concepts and determine modes (TEM, TE, TM) and cutoff frequencies for rectangular waveguides	PO2, PO5	PSO2 (3), PSO3 (2)
CO4	Use modern engineering tools (simulation software/field visualization tools) to model electrostatic and magnetostatic problems.	PO5	PSO3 (3)

VL25404	Microprocessors, Microcontrollers and Interfacing	L	T	P	C
		3	0	2	4

Course Objective:

To study the architecture and operation of 8086 microprocessors, 8051 microcontrollers, and ARM processors, along with their system design principles.

To learn memory and I/O interfacing techniques and develop embedded systems by interfacing processors with supporting peripheral devices.

The 8086 Microprocessor

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation..

8086 System Bus Structure

8086 signals – Basic configurations – System bus timing –System design using 8086 – I/O programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, Closely coupled and loosely Coupled configurations – Introduction to advanced processors.

Microcontroller

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits – Instruction set - Addressing modes - Assembly language programming.

Arm Processor

Processor architecture and organization-Acorn RISC Machine(ARM) - Architectural inheritance-Programmer's model-Data Processing instructions-Data transfer instructions-Control flow instructions-ARM instruction set: Exceptions, Conditional execution, Branch and branch with Link (B, BL), Branch and Branch with Link and eXchange (BX,BLX), Data processing instructions, Multiply instructions, Single and half word data transfer instructions, Multiple register transfer, Swap memory and register(SWP), Status register to general register, General register to status register transfer instructions.

Interfacing Concepts

8086: Memory Interfacing and I/O interfacing - Programming and applications, Case studies: Traffic Light control, 7 Segment LED display, LCD display. 8051: Programming 8051 Timers - Serial Port Programming - Interrupts Programming – ADC, DAC & Sensor Interfacing. ARM7TDMI: On chip: UART, Timer, PWM, Interrupt, External: Hex Keyboard, LED interfacing, Stepper motor

Practical Exercises

List of experiments:

8086 Programs using kits

1. Basic arithmetic (Addition, Subtraction, Multiplication, Division) and Logical operations (AND, OR, XOR and Complement)
2. Sorting (largest, smallest, ascending, descending) and code conversion (Hexadecimal to BCD, Hexadecimal to ASCII)

8086 Peripherals and Interfacing Experiments

3. Study of programmable parallel peripheral interface – 8255
4. Study of programmable interval timer interface – 8253

8051 Experiments using kits

5. Basic arithmetic (Addition, Subtraction, Multiplication, Division) and Logical operations (AND, OR, XOR and Complement)
6. Bit manipulations (Bitwise logical AND, OR and Complement operations)
7. Accessing parallel port IO pins

ARM Processor

8. Basic arithmetic (Addition, Subtraction, Multiplication, Division) and Logical operations (AND, OR, XOR and Complement)
9. Interrupt
10. PWM
11. Stepper motor control

Weightage: Continuous Assessment: 50%, End Semester Examinations: 50%

Assessment Methodology: Quiz (5%), Project (15%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)

References:

1. Yu-Cheng Liu, Glenn A.Gibson, “Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design”, Second Edition, Prentice Hall of India, 2007.
2. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Second Edition, Pearson education, 2011.
3. Doughlas V.Hall, “Microprocessors and Interfacing, Programming and Hardware”,TMH,2012
4. A.K.Ray,K.M.Bhurchandi, "Advanced Microprocessors and Peripherals" 3rd edition, Tata McGrawHill, 2012

CO	Description of CO	PO	PSO
CO1	Define the fundamentals of microprocessors, microcontrollers, embedded systems, processor architectures, memory technologies, and their applications in embedded systems. Understand AI processors, AI accelerator types, future trends, and applications.	–	–
CO2	Apply Embedded C programming concepts, 8051 architecture, memory organization, and basic assembly instructions to develop simple embedded applications.	PO1	PSO3 (3)
CO3	Analyze and design memory and I/O interfacing circuits for microprocessor-based systems	PO2	PSO2 (3), PSO4 (2)
CO4	Design and develop microprocessor / microcontroller/ ARM based systems for real-time and embedded applications.	PO3, PO5	PSO3 (3)

EN25C04	English Communication Skills Laboratory– II	L	T	P	C
		0	0	2	1

Course Objectives:

The objectives of the course are to build students' advanced communication skills for workplace readiness and develop intercultural competence for effective collaboration in global and virtual teams. Prepare students for competitive exams with focused skill-building and test-oriented practice.

List of Activities

Stage Ready – Impactful Public Speaking .

(i) Simulate a formal event such as an academic conference, convocation, or awards ceremony, where students roles including Master of Ceremonies (MC), Role as a dignitary, and a Commentator

(ii) Visual Prompt Storytelling: Use random images to create spontaneous stories, focusing on plot, setting, and character,

(iii) **Digital Presentation - Record** a short video explaining a project or technical concept, using slides, voiceover, and visual aids (to be uploaded using google classroom or drive link)

Professional and Application-Oriented Writing

(i) Résumé Preparation: Design ATS-friendly résumés tailored to various job descriptions, using action verbs and quantifiable impact.

(ii) Design engaging content for poster presentation relevant to their domain.

Receptive Skills in Workplace Communication·

(i) Reading articles related to their domain and discuss in groups

(ii) Visit company websites, make inferences and present in the class

(iii) Listen to recorded mock interviews and take detailed notes. Summarise key points and action items in a professional format and make a presentation.

Intercultural Communication

(i) Assertive vs Aggressive communication

(ii) Role play activities – workplace communication in intercultural/crosscultural contexts

From Campus to Career: Industry Skills and Global Exam Preparation

(i) Participate in HR interviews using AI tools or peer interviewers, responding to behavioural questions using methods like STAR (Situation, Task, Action, Result)

(ii) Practice Verbal Ability in competitive exams like UPSC, SSC, CDS, TNPSC, etc.

Weightage: Continuous Assessment: 60%, End Semester Lab Examinations: 40%.

Internal Assessment Methodology: 1. Oral story telling using visual prompts (30 marks)
2. Poster presentation (40 marks)
3. ATS resume writing (30 marks)

End Semester Assessment:

1. Interview (50 marks)

2. Verbal Ability test (50 marks)
(students must bring the resume but evaluation must be done based on the performance in the interview)

References:

1. Lucas, Stephen, and Paul Stob. The Art of Public Speaking. Thirteenth edition, McGraw-Hill Education, 2020.
2. Abrahams, Matt. Think Faster, Talk Smarter: How to Speak Successfully When You're Put on the Spot. Simon & Schuster, 2023.
3.. Beshara, Tony. Powerful Phrases for Successful Interviews, Rev. ed., McGraw-Hill, 2023.
4. Papalia, Anna. Interviewology: The New Science of Interviewing. Harper Business, 2024.
5. Verbal Ability and Reading Comprehension by Ajay Singh McGraw Hill Education 2020

E-resources:

1. Purdue OWL – Online Writing Lab (Academic and professional writing help)
https://owl.purdue.edu/
2. Canva Resume Builder (Creative, ATS-friendly resume design)
https://www.canva.com/resumes/
3. BBC Learning English – Pronunciation
https://www.bbc.co.uk/learningenglish/english/features/pronunciation
4. India Bix website

	Description of CO	PO	PSO1
CO1	Understand basic industry-related reading materials.	-	-
CO2	Design and present a domain specific poster	PO9(3)	PSO1(2) PSO3(3)
CO3	Deliver effective digital presentations	PO9(3)	PSO2(1)

EC25C16	Linear Integrated Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

- To develop practical skills in electronic circuit design and simulation, and to understand the operation and characteristics of amplifier circuits, feedback amplifiers, oscillators, and multivibrators.

Design And Analysis of the Following Circuits

1. Study of characteristics of Op-amp (Null Balance, CMRR, Slew Rate, Frequency response)
2. Sign Changer and Scale Changer using Op-amp
3. Integrator and Differentiator circuits using Op-Amp
4. Active Filters (low-pass& High pass)
5. PLL as frequency multiplier.
6. R-2R ladder type D-A converter using Op-Amp

Simulation Using Spice (Using Transistor):

1. Tuned Collector Oscillator
2. Twin -T Oscillator / Wein Bridge Oscillator
3. Double and Stagger tuned Amplifiers
4. Bistable Multivibrator
5. Schmitt Trigger circuit with Predictable hysteresis
6. Analysis of power amplifier

Components and Accessories:

Transistors, Resistors, Capacitors, Inductors, diodes, Zener Diodes, Bread Boards, Transformers. SPICE Circuit Simulation Software: (any public domain or commercial software) Note: Op-Amps uA741, LM 301, LM311, LM 324, LM317, LM723, 7805, 7812, 2N3524, 2N3525, 2N3391, AD 633, LM 555, LM 565 may be used

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%),Assignment (10%), Practical (30%), Internal Examinations (30%)

References:

1. J. Bhasker, “A System Verilog : Primer”, 2001

CO	Description of CO	PO	PSO
CO1	Describe the characteristics, configurations, and applications of operational amplifiers and linear integrated circuits used in electronic system design.	--	--
CO2	Analyze linear integrated circuits and amplifier configurations using theoretical concepts and simulation tools to understand circuit behavior and performance.	PO1 (3)	PSO1 (3)
CO3	Evaluate oscillator circuits, multivibrators, filters, and power amplifiers through simulation and experimental results to assess their operational effectiveness.	PO3 (2)	PSO2 (2)
CO4	Design and implement analog circuits such as filters, oscillators, converters, and comparator-based systems using op-amps and simulation software for practical applications.	PO2 (1)	PSO1 (3)

VL25405	Digital VLSI Design Lab	L	T	P	C
		0	0	4	2

Course Objective:
The objective of this course is to introduce HDL programming using System Verilog for design and verification of VLSI circuits. It also aims to provide hands-on practice on EDA tools and get familiar with the VLSI circuit design, functional verification, synthesis and timing simulation.

List of Experiments:

1. Analysis of CMOS process Transistors(NMOS, PMOS)
   a. Plot ID vs. VGS at particular drain voltage (low) for NMOS, PMOS and determine Vt.
   b. Plot log ID vs. VGS at particular gate voltage (high) for NMOS, PMOS and determine IOFF and sub-threshold slope.
   c. Plot ID vs. VDS at different gate voltages for NMOS, PMOS and determine Channel length modulation factor.
   d. Analyse the effect of transistor size on threshold voltage, power and delay.
2. Design a static CMOS inverter and analyze its characteristics (DC characteristics, noise margins, and switching characteristics). Generate Manual / Automatic Layout. Perform Pre-layout and Post-layout simulation. Analyze Area, Power and Timing. Use appropriate EDA Tools.
3. Design and simulate a static CMOS 2 input NAND gate. Generate Manual/ Automatic Layout. Perform Pre-layout and Post-layout simulation. Analyze Area, Power and Timing.
4. Design, simulate and analyse power, and delay of an inverter using Static CMOS, Pass Transistor, Dynamic, Domino, and CVSL logic.
5. Design and simulate CMOS D Flip-Flop, SDFF, TSPC Flip Flop. Analyze the power and delay.
6. Design and simulate a 6T SRAM cell. Perform read and write operations and determine power consumption during read/write. Measure the read and write access time.
7. Design and simulate 1T DRAM.
8. Study of programming with System Verilog (Activity: Flipped class room activity and online quiz.)

   Components of System Verilog- Literal values- data Types – Arrays – Queues- Strings-Composite Type – Expressions – Behavioral modeling, Structural modeling – Packages - Tasks and Functions –Verification using System Verilog: Clocking and Program block – Events - Random constraint generation – Assertions – Immediate

assertions – Concurrent assertions.

9. Write the HDL program for 4 X 1 Multiplexer and 1 X 4 Demultiplexer in Behavioural and Data flow modelling.
10. Demonstrate Arrays and Queues, Task and Functions, Process Control, Random sequence generation, Immediate and Concurrent assertions with System Verilog.
11. Write the HDL program for the following using System Verilog. Perform functional verification, Synthesis (Device Utilization and Timing Report). Verify using System Verilog assertions and perform post synthesis timing simulation.
    i. Adder (Carry skip adder, Carry look ahead adder)
    ii. Multiplier (Array multiplier, Booth multiplier)

Task 1: Low-Power CMOS Circuit Design Project
Design a **low-power CMOS inverter/NAND circuit** using EDA tools, perform layout, and compare pre-layout vs post-layout results.
Task 2: Memory Cell Design for Embedded Systems
Develop a **6T SRAM cell**, simulate read/write operations, and optimize for speed and power consumption for embedded applications.
Task 3: Team-Based HDL Design & Verification
In teams, design and verify a **digital system (MUX/DEMUX or Flip-Flop)** using SystemVerilog with assertions and test benches.
Task 4: Comparative Study of Logic Styles
Analyze different logic families (Static CMOS, Dynamic, Domino, CVSL) and present a report comparing power, delay, and area for real-world VLSI applications.

Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%

Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)

References:

1. J.Bhasker, “A System Verilog : Primer”, 2001

CO	Description of CO	PO	PSO
CO1	Design and analyze basic CMOS circuits (inverters, NAND gates, flip-flops, SRAM/DRAM cells) including power, delay, and layout considerations using EDA tools.	PO4	PSO3(3)
CO2	Develop HDL programs using System Verilog for behavioral and structural modeling, including tasks, functions, arrays, queues, and assertions for verification.	PO1, PO2	PSO3(3)
CO3	Design and simulate arithmetic circuits (adders, multipliers) using System Verilog, perform functional verification, synthesis, and post-synthesis timing analysis.	PO2, PO3, PO5	PSO3(3)
CO4	Evaluate VLSI designs considering power, performance, while working in teams and communicating results effectively.	PO6, PO7, PO8, PO9, PO10, PO11	PSO3(3)