MRK INSTITUTE OF TECHNOLOGY

AN AUTONOMOUS INSTITUTION

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)

KATTUMANNARKOIL- 608 301, CUDDALORE DISTRICT, TAMILNADU, INDIA

CHOICE BASED CREDIT SYSTEM

Programme: B.E – Biomedical Engineering **Regulations:** 2025

Abbreviations:

HUM – Humaniti][es (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.

MRK Institute of Technology 608 301. Kattumannarkoil.

Dr. K. ANANDAVELU, B.E., M.E., Ph.D.,
D.I.S., I.G.C.O.H.S.,M.I.S.T.E.,M.S.E.A (T).,
PRINCIPAL
MRK Institute of Technology
Kattumannarkoil - 608 301.

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 analyze biomedical devices and systems for real time Applications.
2. Utilize modern computational tools, instrumentation, and biomedical imaging Techniques in the health sectors.
3. To keep pace with advancements in biomedical technology and demonstrate Research aptitude, collaborate effectively in teams and uphold ethical practices.

Semester – III							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	BM25C03	Electric Circuit Analysis	T	2-1-2	5	4	ES (PC)
2.	BM25C04	Electronic Devices and Circuits	T	3-0-0	3	3	ES (PC)
3.	BM25C05	Sensors and Measurements	LIT	3-0-2	5	4	ES (PC)
4.	BM25C06	Healthcare Data Analytics	LIT	2-0-2	4	3	ES (PC)
5.		Skill Development Course – I	LIT	1-0-2	3	2	SD
6.	BM25C07	Devices and Circuits Laboratory	L	0-0-4	4	2	ES (PC)
7.	EN25C03	English Communication Skills Laboratory – I	L	0-0-2	2	1	HUM
			Total Credits		**26**	**19**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C06	Probability and Random Processes	T	3-1-0	4	4	BS
2.	BM25C08	Biomedical Instrumentation	T	3-0-0	3	3	ES (PC)
3.	BM25C09	Analog and Digital Integrated Circuits	T	3-0-0	3	3	ES (PC)

4.	BM25C10	Biocontrol Systems	T	3-0-0	3	3	ES (PC)
5.	BM25C11	Medical Ethics and Regulatory Standards	T	3-0-0	3	3	ES (PC)
6.		Skill Development Course – II	LIT	1-0-2	3	2	SD
7.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
8.	BM25C12	Analog and Digital Integrated Circuits Laboratory	L	0-0-4	4	2	ES (PC)
				Total Credits	**25**	**21**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Diagnostic and Therapeutic Equipment	T	3-0-0	3	3	ES (PC)
2.		Radiological Equipment	T	3-0-0	3	3	ES (PC)
3.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
4.		Programme Elective – II	T	3-0-0	3	3	ES (PE)
5.		Microcontrollers and Embedded Systems	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
8.		Industry Oriented Course – I	LIT	1-0-2	3	1	SD
9.		Summer Internship	LIT	0-0-4	4	2	SD
				Total Credits	**32**	**25**	
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.		Advanced Diagnostic and therapeutic equipment	T	3-0-0	3	3	ES (PC)
2.		Biomechanics	T	3-0-0	3	3	ES (PC)
3.		Open Elective	T	3-0-0	3	3	ES (OE)
4.		Programme Elective – III	LIT	3-0-2	5	4	ES (PE)
5.		Industry Oriented Course – II	LIT	1-0-2	3	1	SD
6.		Biomedical System Modeling Laboratory	L	0-0-4	4	2	ES (PC)
7.		Diagnostic and Therapeutic Equipment Laboratory	L	0-0-4	4	2	ES (PC)
8.		Self-Learning Course	---	---	0	1	SL
				Total Credits	**25**	**19**	
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		Climate Change and Sustainability	T	2-0-0	2	2	HUM
2		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
3		Programme Elective – V	T	3-0-0	3	3	ES (PE)

4		Hospital Management	T	3-0-0	3	3	HUM
5		Wearable Systems	T	3-0-0	3	3	ES (PC)
6		Innovation and Entrepreneurship in Healthcare	LIT	2-0-2	4	3	---
7		Medical Image Processing	LIT	3-0-2	5	4	ES (PC)
8		Hospital Training*	---	---	--	2	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**	

PROGRAMME ELECTIVE COURSES: STREAMS

Bio Engineering	Digital Health	Medical Device Development	Assistive Technology	Management Healthcare
Biomaterials	Biosignal Processing	Foundation Skills in Integrated Product Development	Extended Reality in Healthcare	Clinical Engineering
Artificial Organs and Implants	Telehealth Technology	Medical Device Design	Rehabilitation Engineering	Hospital Planning and Management
Neural Engineering	Brain Computer Interface and Applications	Advancements in Healthcare Technology	Physiological Modelling	Medical Waste Management
Principles of Tissue Engineering	Biometrics	Rapid Prototyping	Assistive Technology and devices	Economics and Management for Engineers
Health informatics	Soft Computing and its applications	Internet of Medical Things	Robotics in Medicine	Forensic Science in Healthcare
BIOMEMS	Deep Learning	Biomedical Optics and Photonics	Sports Engineering and Technology	Quality Management in Hospital

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.

Unit I Functions, Limits and Continuity **12**

Functions, graph of functions, New functions from old functions, Limit of a function, Continuity, Limits at infinity function.

Activities: Visualization of functions and their transformations using open-source software, Solving application-oriented problems involving functions, limits and continuity.

Unit II Differential Calculus and Applications **12**

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: Graphical interpretation of derivatives as slopes of tangent lines using open-source software, Solving of Competitive Examination questions (Ex. GATE).

Unit III Functions of Several Variables **12**

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).

Unit IV Integral Calculus **12**

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).

Unit V Multiple Integrals **12**

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%).

TOTAL: 60 PERIODS

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	Analyze functions, limits, continuity, and their graphical representations to solve engineering-related problems.	---	---
CO2	Apply differential calculus, mean value theorem, and optimization techniques to analyze and solve engineering problems.	PO1(3)	PSO1(2) PSO2(2)
CO3	Apply partial derivatives, chain rule, total derivatives, and Lagrange multipliers to analyze functions of several variables and solve engineering applications.	PO2(3)	PSO2(3) PSO3(2)
CO4	Apply integral calculus techniques to evaluate integrals, arc lengths, areas, and volumes relevant to engineering applications.	PO5(2) PO11(1)	PSO1(2) PSO2(3) PSO3(2)
CO5	Evaluate double and triple integrals using appropriate coordinate transformations and apply multiple integration techniques to engineering problems.	PO5(2) PO11(1)	PSO1(2) PSO2(3) PSO3(2)

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.

Unit I Listening Skills . **9**

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

Suggested Activities: Listening and Repeating, Note-taking

Unit II Speaking Skills **9**

Self-Introduction, Expressing opinions, Participating in Conversations, Speech Acts - agreeing & disagreeing.

Suggested Activities: Just a Minute (JAM) Video recording, Situational role plays, Usage of Apps.

Unit III Reading Skills **9**

Reading Strategies – Skimming, Scanning, Predicting, Intensive reading - short passages and long passages on suggested themes.

Suggested Activities: Reading - newspaper and digital articles, Reading comprehension, note making and summarizing.

Unit IV Writing Skills **9**

Hints Development, Guided Writing, Writing Different Types of Paragraphs, Sentence Structure, Sentence Formation, Letter Writing, Emails (Formal & Informal).

Suggested Activities: Picture and poster description, Brainstorming and Mind Mapping.

Unit V Grammar and Vocabulary **9**

Tenses, Adjectives, Subject-Verb Agreement, Sentence Patterns, Synonyms and Antonyms, Word Substitution, Prefixes and suffixes, Idioms and Phrases.

Suggested Activities: Gap fills exercises, Cloze Test, Error Detection and Spell Bee.

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%).

Total Hours:45

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

அலகு I மொழி மற்றும் இலக்கியம் **3**

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

அலகு II மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை **3**

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

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் **3**

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

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள் **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும் கல்வியும் – சங்ககால நகரங்களும் துறைமுகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்தியப் பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு **3**

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

TOTAL: 15 PERIODS

References:

1. **தமிழக வரலாறு – மக்களும் பண்பாடும் – டாக்டர் க.க. 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 ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

	Description of CO	PO	PSO
CO1	தமிழ் மொழி மற்றும் இலக்கியத்தின் வளர்ச்சி மற்றும் சிறப்புகளை விளக்குதல்.	PO1(2) PO2(2)	PSO3(2)
CO2	தமிழர்களின் பாரம்பரியக் கலைகள், சிற்பக்கலை, கைவினைப் பொருட்கள் மற்றும் இசைக்கருவிகளை அறிந்து பாராட்டுதல்.	PO1(2) PO7(3)	PSO1(1) PSO3(2)
CO3	தமிழர்களின் நாட்டுப்புறக் கலைகள், பாரம்பரிய விளையாட்டுகள் மற்றும் வீரக் கலைகளை விளக்குதல்.	PO7(3) PO8(3)	PSO3(2)
CO4	தமிழர்களின் திணைக் கோட்பாடுகள், சங்ககால கல்வி, நகர வளர்ச்சி மற்றும் கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றிகளை அறிதல்.	PO2(3) PO6(3) PO7(3)	PSO2(2) PSO3(2)
CO5	இந்திய விடுதலை இயக்கம், மருத்துவம், பண்பாடு, கல்வெட்டுகள் மற்றும் அச்சு வரலாற்றில் தமிழர்களின் பங்களிப்பை அறிதல்.	PO2(3) PO6(3) PO7(3) PO11(1)	PSO2(2) PSO3(3)

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

Unit I Language and Literature **3**

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

Unit II Heritage - Rock Art Paintings to Modern Art – Sculpture **3**

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

Unit III Folk and Martial Arts **3**

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

Unit IV Thinai Concept of Tamils **3**

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

Unit V Contribution of Tamils to Indian National Movement and Indian Culture **3**

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

TOTAL: 15 PERIODS

References:

1. **தமிழக வரலாறு – மக்களும் பண்பாடும் – டாக்டர் க.க. 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: InternationalInstitute 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 ofArchaeology & 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.

	Description of CO	PO	PSO
CO1	Explain the development and significance of Tamil language and literature.	PO1(2) PO2(2)	PSO3(2)
CO2	Understand and appreciate traditional Tamil art, sculpture, crafts, and musical instruments.	PO1(2) PO7(3)	PSO1(1) PSO3(2)
CO3	Describe Tamil folk arts, traditional games, and martial practices.	PO7(3) PO8(3)	PSO3(2)
CO4	Explain Tamil ecological concepts, social values, education, trade, and maritime achievements.	PO2(3) PO6(3) PO7(3)	PSO2(2) PSO3(2)
CO5	Understand the contribution of Tamils to the Indian freedom movement, medicine, culture, inscriptions, and printing history.	PO2(3) PO6(3) PO7(3) PO11(1)	PSO2(2) PSO3(3)

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

Unit I Basic Electronics **9**

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.

Unit II Electrical Machines **9**

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.

Unit III Measurements and Instrumentation **9**

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

Unit IV Basics of Power Systems **9**

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

Unit V Sensors and Transducers **9**

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%)

TOTAL: 45 PERIODS

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 (3)	PSO1(3) PSO2(2)
CO3	Apply measurement and instrumentation techniques to measure electrical quantities using appropriate instruments.	PO1 (3) PO2 (3) PO4 (3)	PSO1(3) PSO2(3) PSO3(2)
CO4	Explain the basic structure of power systems, electrical protection and safety practices.	PO1 (3) PO2 (3) PO6 (3)	PSO2(3) PSO3(2)
CO5	Explain the working principles and applications of sensors and transducers used in modern engineering systems.	PO1 (3) PO4 (3) PO5 (3)	PSO1(3) PSO2(3) PSO3(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.

Unit I Properties of Matter **12**

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.

Unit II Oscillations and Waves **12**

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

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

Unit III Quantum Mechanics **12**

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

Unit IV Applied Optics **12**

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.

Practical: Thickness of a thin sheet/wire using Air wedge Method.

Activities: Demonstration of sensors.

Unit V Laser and its Application **12**

Einstein Co-efficient - Nd: YAG laser, CO_2 laser (construction, functioning and applications), dye laser

Practical: Ruling width of Compact disc using Laser.

Activities: Demonstration of 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%)

TOTAL: 60 PERIODS

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 and understand the properties of matter.	---	---
CO2	Explain oscillations, waves, and electromagnetic wave propagation.	PO1(3)	PSO2(3) PSO3(2)
CO3	Apply quantum mechanical principles to understand microscopic phenomena and quantum devices.	PO1(3) PO2(3)	PSO1(2) PSO2(3)
CO4	Explain interference and fiber optic sensors.	PO1(3) PO2(3)	PSO1(3) PSO2(3)
CO5	Apply the principle of laser physics in practical systems.	PO1(3) PO4(3) PO5(3)	PSO1(3) PSO2(3) PSO3(3)

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.

Unit I Water Technology **12**

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

Unit II Nano-chemistry **12**

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

Practical: Preparation of nanoparticles by Sol-Gel method.

Unit III Electrochemistry **12**

Electrochemical cell - Electrode potential- Redox reaction. Conductivity of electrolytes – Factors.

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

Unit IV Corrosion & Control **12**

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

Unit V Batteries **12**

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%)
TOTAL: 60 PERIODS

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	Explain water quality, treatment, desalination, remediation, and analyze key water quality parameters.	---	
CO2	Analyze nanomaterial classification, properties, synthesis, and applications.	PO1(3) PO2(2)	PSO1(3) PSO2(2)
CO3	Evaluate electrochemical cells, redox reactions, conductivity, and conductometric titrations.	PO2(2)	PSO1(2) PSO2(1)
CO4	**Assess corrosion mechanisms, factors, prevention methods, coatings, and testing techniques.**	PO2(2) PO4(3) PO5(2)	PSO2(3)
CO5	Evaluate battery technologies, performance, testing, and safety.	PO3(3) PO6(2)	PSO1(3) PSO2(2)

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.

Unit I Introduction to C **13**

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).

Unit II Control Structures and Functions **13**

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

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 conditional logics in programs. (Minimum three)
- Usage of functions in programs. (Minimum three)

Unit III Arrays, Strings and Pointers **12**

Arrays: One-dimensional and Multi-dimensional Arrays, Array operations and traversals

Strings & Pointers: 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)

Unit IV Structures and Unions **10**

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

Practical:

- Program to use structures and unions

Unit V File Operations, Standard Libraries & Header Files **10**

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

Using standard libraries like stdio.h, stdlib.h, string.h, math.h, Creating and using user-defined header files and libraries.

Practical:

- Programs reading/writing data in text and binary files (Minimum three).
- 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%)

TOTAL: 60 PERIODS

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 (4th ed.). 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	Develop algorithms, flowcharts, and basic C programs for problem solving.	PO1 (3) PO2 (2)	PSO1 (3)
CO2	Implement control structures, functions, and modular programming in C.	PO2 (3) PO5 (2)	PSO1 (3)
CO3	Apply arrays, strings, pointers, and dynamic memory allocation in C programming.	PO2 (2) PO3 (3) PO5 (2)	PSO1 (3) PSO2 (2)
CO4	Construct C programs using structures and unions.	PO3 (3) PO5 (3)	PSO1 (3) PSO2 (3)
CO5	Develop C applications using file handling techniques, standard libraries, user-defined libraries and mini projects.	PO3 (3) PO5 (3) PO9 (2) PO12 (2)	PSO1 (3) PSO2 (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.
TOTAL: 60 PERIODS

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.

Unit I Personal and Emotional Development **15**

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.

Unit II Management Skills **15**

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%)

TOTAL: 30 PERIODS

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%)

TOTAL: 60 PERIODS

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:

1. **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.

Unit I Vector Spaces **12**

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.

Unit II Linear Transformations and Diagonalization **12**

Null space, Range, Dimension Theorem (statement only), Matrix representation of a linear transformation.

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

Unit III Eigen Value Analysis **12**

Eigenvalues & Eigenvectors- Linear Independence of Eigenvectors – Diagonalization of Matrices – Conditions for Diagonalizability – Construction of Modal Matrix – Applications of Diagonalization – Simple problems (up to 3×3 matrices).

Activities: Open-source software, exercises to compute eigenvalues and eigenvectors of matrices, determine Eigen spaces, verify linear independence of eigenvectors, test the diagonalizability of matrices, construct the modal matrix, and verify diagonalization using computational tools.

Unit IV Inner Product Spaces **12**

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.

Unit V Matrix Decomposition **12**

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%).
TOTAL: 60 PERIODS

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	Apply linear transformations and determine null spaces and ranges.	PO1(3) PO2(3)	PSO1(1)
CO3	Compute and interpret eigenvalues and eigenvectors.	PO1(3) PO2(3) PO3(3) PO4(3)	PSO1(2) PSO2(3)
CO4	Apply inner product concepts and Gram–Schmidt orthogonalization.	PO1 (3) PO2 (3)	PSO2(3)
CO5	Compute least squares solutions of linear system of equations and se MATLAB to implement and validate key linear algebra concepts	PO5 (3) PO11 (2)	PSO1(3) PSO2(3)

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

அலகு I – நெசவு மற்றும் பானைத் தொழில்நுட்பம் 3

சங்க காலத்தில் நெசவுத் தொழில், பானைத் தொழில்நுட்பம், கருப்பு சிவப்பு பானைகள், பானைகளில் கீறல் குறியீடுகள்.

அலகு II – வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம் 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள், சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு, சங்க காலத்தில் கட்டுமானப் பொருட்களும் நடுகல்லும், சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள், மாமல்லபுரச் சிற்பங்களும் கோவில்களும், சோழர் காலப் 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-சாரசெனிக் கட்டிடக் கலை.

அலகு III – உற்பத்தித் தொழில்நுட்பம் 3

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

அலகு IV – வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம் 3

அணை, ஏரி, குளங்கள், மதகு, சோழர் காலக் குமிழித் தூம்பின் முக்கியத்துவம், கால்நடை பராமரிப்பு, கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள், வேளாண்மை மற்றும் வேளாண்மை சார்ந்த செயல்பாடுகள், கடல்சார் அறிவு, மீன்வளம், முத்து மற்றும் முத்துக்குளித்தல், பெருங்கடல் குறித்த பண்டைய அறிவு, அறிவுசார் சமூகம்.

அலகு V – அறிவியல் தமிழ் மற்றும் கணித்தமிழ் 3

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%)

TOTAL: 15 PERIODS

References

1. **தமிழக வரலாறு – மக்களும் பண்பாடும் –** டாக்டர் க.க. 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.

	Description of CO	PO	PSO
CO1	தமிழர்களின் நெசவு மற்றும் பானைத் தொழில்நுட்பங்களை அறிதல்.	---	---
CO2	தமிழர்களின் வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்ப வளர்ச்சியைப் புரிந்துகொள்ளுதல்.	PO1(3) PO2(3)	PSO2(2) PSO3(2)
CO3	தமிழர்களின் உற்பத்தித் தொழில்நுட்பம், உலோகவியல் மற்றும் கைவினைத் தொழில்களை அறிதல்.	PO1(2) PO2(2) PO3(2) PO7(3)	PSO2(2) PSO3(2)
CO4	தமிழர்களின் வேளாண்மை, நீர்ப்பாசனம் மற்றும் கடல்சார் தொழில்நுட்பங்களைப் புரிந்துகொள்ளுதல்.	PO2(3) PO6(3)	PSO2(2) PSO3(3)
CO5	அறிவியல் தமிழ், கணித்தமிழ் மற்றும் தமிழ் கணினித் தொழில்நுட்பத்தின் வளர்ச்சியை அறிதல்.	PO1(2) PO2 (2) PO5(3)	PSO1(2) PSO2(3) PSO3(3)

UC25H02	Tamils and Technology	L	T	P	C
		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 –** டாக்டர் க.க. 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.

	Description of CO	PO	PSO
CO1	**Explain** the textile and pottery technologies of the Tamils.	---	---
CO2	**Describe** the development of design and architectural technologies of the Tamils.	PO1(3) PO2(3)	PSO2(2) PSO3(2)
CO3	**Examine** the manufacturing, metallurgy, and handicraft technologies of the Tamils.	PO1(2) PO2(2) PO3(2) PO7(3)	PSO2(2) PSO3(2)
CO4	**Analyze** the agricultural, irrigation, and maritime technologies of the Tamils.	PO2(3) PO6(3)	PSO2(2) PSO3(3)
CO5	**Explore** the development of Scientific Tamil and Computational Tamil.	PO1(2) PO2 (2) PO5(3)	PSO1(2) PSO2(3) PSO3(3)

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.

Unit I Oral Communication **9**

Types - Verbal and Nonverbal, Interpersonal and Group communication, Telephonic conversation.

Suggested Activities: Short presentations, Listen and respond to short podcasts**.**

Unit II Conversational Skills **9**

Formal Speeches, Welcome Address, Vote of Thanks and Introducing Chief guests, Brainstorming and Group discussions.

Suggested Activities: Debates, Role Play.

Unit III Business Correspondence **9**

Email Communication, Formal Letters & Types - Complaint, Request and Permission Letters, Business Meeting.

Suggested Activities: Agenda, Minutes of the Meeting.

Unit IV Academic Writing **9**

Paraphrasing, Summarizing, Essay Writing - Cause and Effect, Argumentative, Persuasive, Instructions and Recommendations.

Suggested Activities: User guides/ manuals, Policy document.

Unit V Team Work **9**

Leadership Skills - Team building, Team Leader, Team player, Negotiation and Problem solving skills.

Suggested Activities: SWOT Analysis.

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

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

TOTAL: 45 PERIODS

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.

Unit I Semiconductor **9**

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.

Unit II PN Junction Diodes and Special Diodes **9**

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.

Unit III Bipolar Junction Transistors **9**

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.

Unit IV Field Effect Transistors **9**

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.

Unit V Thyristors, UJT and Optoelectronic Devices **9**

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%)

TOTAL: 45 PERIODS

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** semiconductor properties, carrier transport, and continuity equations.	PO1 (3)	PSO1(3)
CO2	**Analyze** the characteristics and applications of PN junction and special diodes.	PO1 (3) PO2 (3)	PSO1(3) PSO2(2)
CO3	**Explain** the operating characteristics of bipolar junction transistors in different configurations.	PO1 (2)	PSO1(3) PSO2(3)
CO4	**Analyze** the characteristics and operation of JFET, MOSFET, and CMOS devices.	PO2 (3) PO5 (2)	PSO2(3) PSO3(3)
CO5	Apply the principles of thyristors, UJT, optoelectronic devices, and power MOSFETs in electronic circuits.	PO1 (3) PO2 (3)	PSO1(2) PSO2(3) PSO3(3)

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.

Unit 1 Circuit Laws **9**

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.

Unit II Network Theorems **9**

Source transformation techniques, Star delta transformation techniques, principle of linearity, Thevenin's and Norton's theorems, Superposition theorem, Maximum power transfer theorem, Reciprocity theorem.

Unit III Steady-State and Transient Analysis of Ac and DC Circuits **9**

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.

Unit IV Resonance and Coupled Circuits **9**

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.

Unit V Linear Two-Port Network Analysis **9**

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%)

TOTAL: 45 PERIODS

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, mesh analysis and nodal analysis and the behavior of circuit components	---	---
CO2	Apply network theorems and transformation techniques to simplify electrical circuits.	PO1 (2) PO2 (3) PO3 (2)	PSO1(2) PSO2(3)
CO3	Analyze and evaluate the steady-state and transient behaviors of RL RC, RLC circuits.	PO2 (3) PO3 (2) PO4 (2)	PSO1(2) PSO2(3)
CO4	Evaluate resonance, coupled circuits, and transformer characteristics.	PO1 (3) PO2 (3) PO4 (2)	PSO1(3) PSO2(3)
CO5	Analyze two-port networks using different network parameters and their interconnections.	PO1 (3) PO2 (3) PO5 (2)	PSO1(3) PSO2(3) PSO2(2)

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++.

Unit I Data Abstraction & Overloading **15**

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.

Unit II Inheritance & Polymorphism **15**

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.

Unit III Linear Data Structures **15**

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

Unit IV Non-Linear Data Structures **15**

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.

Unit V Searching, Sorting and Complexity Analysis **15**

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%)

TOTAL: 75 PERIODS

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	Apply C++ concepts such as classes, constructors, destructors, friend functions, and overloading.	PO1(3)	PSO1(2)
CO2	Implement inheritance, polymorphism, virtual functions, and dynamic binding.	PO1(3) PO2(3)	PSO1(2) PSO2(3)
CO3	Analyze linear data structures and their operations using appropriate representations.	PO1(2) PO2(3) PO5(2)	PSO1(2) PSO2(3)

CO4	Implement trees and graph algorithms to solve non-linear data structure problems.	PO2(2) PO3(3)	PSO1(2) PSO2(3)
CO5	Analyze searching and sorting algorithms based on their performance	PO1(2) PO2(3) PO5(2)	PSO1(3) PSO2(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:

1. 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) 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 (2nd ed.). 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

BM25C03	Electric Circuit Analysis	L	T	P	C
		2	1	2	4

Course Objective:

To introduce the basic concepts of DC and AC circuits behavior and to study the transient and steady state response of the circuits subjected to step and sinusoidal excitations and different methods of circuit analysis using Network theorems, duality and topology.

Unit I DC Circuit Analysis **15**

Basic Components of electric Circuits, Charge, current, Voltage and Power, Voltage and Current Sources, Ohms Law, Kirchhoff's Current Law, Kirchhoff's voltage law, the single Node – Pair Circuit, series and Parallel Connected Independent Sources, Resistors in Series and Parallel, voltage and current division, Nodal analysis & Mesh analysis using Independent and Dependent Sources. Super Mesh, Super Node.

Practical's

- Verification of Mesh Analysis for DC Circuits.
- Verification of Nodal Analysis for DC Circuits.

Unit II Network Theorem **15**

Useful Circuit Analysis techniques using Independent and Dependent Sources - Linearity and superposition, Reciprocity Theorem, Thevenin and Norton Equivalent Circuits, Maximum Power Transfer, Delta-Wye Conversion. Duality**:** Duals, Dual circuits.

Practical's

- Verification of Thevenin, Norton & Super Position Theorems for DC Circuits.
- Verification of Maximum Power Transfer & Reciprocity Theorems for DC Circuits

Unit III Sinusoidal Steady State Analysis **15**

State analysis, Characteristics of Sinusoids, The Complex Forcing Function, The Phasor, Phasor relationship for R, L, and C, impedance and Admittance, Nodal and Mesh Analysis, Phasor Diagrams, AC Circuit Power Analysis, Instantaneous Power, Average Power, apparent Power and Power Factor, Complex Power.

Practical's

- Verify mesh and nodal analysis for AC circuits.

Unit IV Transients And Resonance in RLC Circuits **15**

Basic RL and RC Circuits, The Source- Free RL Circuit, The Source-Free RC Circuit, The Unit- Step Function, Driven RL Circuits, Driven RC Circuits, RLC Circuits, Frequency Response, Parallel Resonance, Series Resonance, Quality Factor, Coupled Circuits - Magnetically Coupled Circuits, mutual Inductance, the Linear Transformer, the Ideal Transformer.

Practical's

- Determination of Resonant Frequency of Series & Parallel RLC Circuits.
- Study of DC transients in RL, RC and RLC circuits

Unit V Topology **15**

An introduction to Network Topology, Trees and General Nodal analysis, Links and Loop analysis

Activity:

- Simulate the DC and AC circuits using simulation tools
- Determine phasor relationship, real power (P), reactive power (Q), apparent power (S) and power factor in AC circuits using EDA tools

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

Assessment Methodology: Solving of GATE questions (30%), Software activity (30%), Internal Examinations (40%).

TOTAL : 75 PERIODS

References:

1. Hayt, J., Kemmerly, S., & Durbin, S. (2024). Engineering circuit analysis (10th ed.). McGraw-Hill Education.
2. Boy lestad, R. L. (2014). Introductory circuit analysis (12th ed.). Pearson Education India.
3. Alexander, C. K., & Sadiku, M. N. O. (2022). Fundamentals of electric circuits (7th ed.). McGraw-Hill.
4. Cunningham, D. R., & Stuller, J. A. (2005). Basic circuit analysis. Jaico Publishing House.
5. Bell, D. (2009). Fundamentals of electric circuits (7th ed.). Oxford University Press.
6. Mallay, J. O. (2011). Schaum's outlines: Basic circuit analysis (2nd ed.). McGraw-Hill.

E-Resources

- https://nptel.ac.in/courses/117106148
- https://nptel.ac.in/courses/117106108
- https://ec-amrt.vlabs.ac.in/
- https://bes-iitr.vlabs.ac.in/List%20of%20experiments.html

CO	Description of CO	PO	PSO
CO1	Explain and apply fundamental electrical laws (Ohm's Law, KCL, KVL) to analyse DC circuits.	-	-
CO2	Analyze electrical networks using nodal, mesh analysis and network theorems.	PO2 PO4	PSO1(2) PSO2(3)
CO3	Evaluate steady-state behavior of AC circuits using phasors and power concepts.	PO2 PO4	PSO1(3) PSO2(3)
CO4	Analyze transient response of RL, RC, and RLC circuits under different excitations.	PO3, PO5, PO11	PSO1(3) PSO2(3)
CO5	Apply network topology concepts to analyze electrical networks using tree, loop, and generalized nodal analysis techniques.	PO1, PO2, PO5	PSO1(2) PSO2(3) PSO3(2)

BM25C04	Electronic Devices and Circuits	L	T	P	C
		3	0	0	3

Course Objective:

This course aims to provide a solid foundation in the principles, characteristics, and applications of semiconductor devices such as diodes, BJTs, and FETs and design basic electronic circuits for rectification, amplification, and switching purposes, special and power semiconductor devices used in modern electronic and optoelectronic systems.

Unit I Semiconductor Diodes **9**

PN junction diode, Current equations, Energy Band diagram, Diffusion and drift current densities, forward and reverse bias characteristics, Transition and Diffusion Capacitances, Switching Characteristics, Breakdown in PN Junction Diodes, Zener diodes, tunnel diode, LDR, p-i-n diode.

Unit II Diode Applications **9**

Load Line Analysis, Series Diode Configurations with DC Inputs, Parallel and Series-Parallel Configurations, Half-Wave Rectification. Full-Wave Rectification. Clippers. Clampers. Zener Diodes. Voltage Multiplier Circuits.

Unit III Bipolar Junction Transistors **9**

NPN and PNP Transistor Operation. Common-Base Configuration. Common-Emitter Configuration. Limits of Operation. DC Biasing-BJTs. Operating Point. Fixed-Bias Circuit. Emitter-Stabilized Bias Circuit. Voltage-Divider Bias. DC Bias with Voltage Feedback. BJT small signal model, high frequency model– Analysis of CE amplifier - Gain and frequency response.

Unit IV Field Effect Transistors **9**

MOSFETs – Drain and Transfer characteristics, -Current equations -Pinch off voltage and its significance- Threshold voltage -Channel length modulation, D MOSFET, E-MOSFET- Characteristics.

Unit V Feedback Amplifiers and Oscillators **9**

Basic concepts of feedback –negative feedback, series, Shunt feedback – Positive feedback – Condition for oscillations – RC phase shift – Wien bridge, Hartley, Colpitts and Crystal oscillators, Power amplifiers-Class A and Class B.

Activity

- Simulate the analog circuits using EDA tools.

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

Assessment Methodology: Solving of GATE questions (30%), Software activity (30), Internal Examinations (40%).

TOTAL : 45 PERIODS

References

1. Boylestad, R. L., & Nashelsky, L. (2014). Electronic devices and circuit theory (11th ed.). Pearson Prentice Hall.
2. Bhattacharya, P., & Sharma, S. (2014). Solid state electronic devices (2nd ed.). Oxford University Press.
3. Sedha, R. S. (2010). A textbook of electronic devices and circuits (1st ed.). S. Chand Publications.
4. Bell, D. A. (2008). Electronic devices and circuits (5th ed.). Oxford University Press.
5. Hanan, S. S., & Kumar, S. N. (2022). Electronic devices and circuits (5th ed.). McGraw-Hill.

e-Resources:

- https://www.vlab.co.in/broad-area-electronics-and-communications
- https://be-iitkgp.vlabs.ac.in/
- http://vlabs.iitkgp.ac.in/be/`

CO	Description of CO	PO	PSO
CO1	Explain the principles, characteristics, and operation of semiconductor diodes and their applications.	-	-
CO2	Analyze and design diode circuits for rectification, clipping, clamping, and voltage regulation.	PO2 PO4	PSO1(3) PSO2(3)
CO3	Design and analyze the operation and biasing of BJTs and FETs, and analyze their small-signal models.	PO1 PO2	PSO1(3) PSO2(3)
CO4	Design and analyze amplifier circuits, feedback amplifiers, and oscillators using BJTs and FETs.	PO3, PO5,	PSO2(3) PSO2(3)
CO5	Analyze and design feedback amplifiers, oscillators, and power amplifiers for analog electronic applications.	PO2, PO3, PO5	PSO1(3) PSO2(3)

BM25C05	Sensors and Measurements	L	T	P	C
		3	0	2	4

Course Objective:

Acquire knowledge about the various blocks of a typical measurement system. Study the characteristics of different transducers, signal conditioning circuit and display devices.

Unit I Science of Measurement **15**

Measurement System – Instrumentation – Classification and Characteristics of Transducers – Static and Dynamic – Errors in Measurements – Calibration and standards – Primary and secondary standards.

Unit II Displacement, Pressure, Temperature Sensors **15**

Resistive Transducers: Strain Gauge: Gauge factor, sensing elements, configuration, strain gauge as displacement & pressure transducers, biomedical applications. RTD materials & range, Characteristics, thermistor characteristics, biomedical applications of Temperature sensors, Capacitive transducer, Inductive transducer, LVDT, Active type: Thermocouple characteristics.

Activity:

- Case studies on various biomedical application of transducers.

Practical's:

- Characteristics of strain gauges.
- Displacement measurement using LVDT.
- Characteristics of temperature transducer-thermistor, RTD, Thermocouple.

Unit III Photoelectric And Piezoelectric Sensors **15**

Phototube, scintillation counter, Photo Multiplier Tube (PMT), photovoltaic, Photo conductive cells, photo diodes, phototransistor, comparison of photoelectric transducers, spectrophotometric applications of photo electric transducers. Piezoelectric active transducer and biomedical applications as pressure & Ultrasound transducer.

Activity:

- Project- Develop biomedical applications using different sensors

Practical's:

- Characteristics of Photo electronic transducers-LDR, Photo Diode, Photo Transistor.

Unit IV Signal Conditioning & Display Devices **15**

AC and DC Bridges – Wheat stone bridge, Kelvin, Maxwell, Hay, Schering – Concepts of filters, low pass, high pass, band pass, band stop, notch-pre-amplifier, differential amplifier – impedance matching circuits – isolation amplifiers, Spectrum Analyzer, Digital voltmeter – Multi meter – CRO – block diagram, CRT – vertical & horizontal deflection system, DSO.

Practical's:

- Wheatstone Bridge for Measurement of Resistance.
- Measurement of capacitance using bridge circuits.
- Measurement of inductance using bridge circuits.
- Characteristics of passive filters

Unit V Biosensors **15**

Introduction**,** Advantages and limitations, various components of biosensors, Classification of Biosensors Based on Type of Transduction – Electrochemical, Optical,

Acoustic, Calorimetric. Classification of Biosensors Based on Biological Element – Enzyme Sensor, Immunosensors. Ion selective Field Effect Transistor (ISFET), immunologically sensitive FET (IMFET), Blood glucose sensors.

Activity:

- Simulation of Biosensor using simulation tools (COMSOL Multiphysics/ Intelli suite / etc.).

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

Assessment Methodology: Project (20%), Simulation (15%), Activity (10%), Practical (25%), Internal Examinations (30%)

TOTAL : 75 PERIODS

References:

1. Doebelin, E. O., & Manik, D. N. (2020). Measurement systems (7th ed.). Tata McGraw-Hill Education Pvt. Ltd.
2. Sawhney, A. K. (2023). Electrical & electronics measurement and instrumentation. Dhanpati Rai & Co.
3. Geddes, L. A., & Baker, L. E. (2008). Principles of applied biomedical instrumentation (3rd ed., reprint). John Wiley & Sons.
4. Khandpur, R. S. (2024). Handbook of biomedical instrumentation (3rd ed.). Tata McGraw Hill.
5. Cromwell, L., Weibell, F. J., & Pfeiffer, E. A. (2013). Biomedical instrumentation and measurement (2nd ed., reprint). Prentice Hall India Pvt. Ltd.

E-Resources

- https://sl-coep.vlabs.ac.in/
- https://www.vlab.co.in/ba-nptel-labs-electrical-engineering
- https://www.comsol.com/support/learning-center

CO	Description of CO	PO	PSO
CO1	Explain the principles of measurement systems, instrumentation, transducers, and standards, including errors and calibration.	-	-
CO2	Analyze and characterize displacement, pressure, and temperature sensors and their applications in engineering and biomedical systems.	PO2, PO4	PSO2(3) PSO3(3)
CO3	Analyze the operation and applications of photoelectric and piezoelectric sensors.	PO2, PO4	PSO2(3) PSO3(3)
CO4	Design and implement signal conditioning circuits and interface with display devices for accurate measurement.	PO3, PO5	PSO2(3) PSO3(3)
CO5	Classify, and simulate biosensors, including electrochemical, optical, and FET-based biosensors, using modern simulation tools.	PO3, PO5, PO11	PSO2(3) PSO3(3)

BM25C06	Healthcare Data Analytics	L	T	P	C
		2	0	2	3

Course Objective:

To comprehend the fundamental of mathematical and statistical theory in the application of Healthcare, Apply the regression and correlation analysis on the healthcare data an Understand the Meta analysis and variance analysis, Interpret the results of the investigational methods.

Unit I Introduction **12**

Electronic Health record- Components, Coding systems- International classification of diseases (ICD), LOINC, DICOM, Introduction to probability, likelihood & odds, distribution variability.

Unit II Statistical Parameters **12**

p-values, computation, level chi square test and distribution and hypothesis testing - single population proportion, difference between two population proportions, single population variance, tests of homogeneity. Testing of statistical parameters using appropriate software R / Python.

Practicals:

- Finding the statistical distribution using appropriate software tool like R/ Python.
- Perform basic data exploration and visualization of a healthcare dataset

Unit III Regression and Correlation Analysis **12**

Regression model, evaluating the regression equation, correlation model, correlation coefficient.

Practicals:

- Finding regression, correlation for the data using appropriate software like R / Python.
- Testing the variance using appropriate software tool like R / Python.

Unit IV Analysis Of Variance **12**

META analysis for research activities, purpose and reading of META analysis, kind of data used for META analysis, completely randomized design, randomized complete block design, repeated measures design, factorial experiment.

Practicals:

- Analysis of data from wearables devices.
- Testing the variance using appropriate software tool like R / Python.

Unit V Case Studies **12**

Epidemical reading and interpreting of epidemical studies, application in community health, Case study on Medical Imaging like MRI, CT. Case study on respiratory data, Case study on ECG data. Predictive models to detect onset of disease

Specific Activity:

- Project based learning- Implement data analytics on healthcare data using 'R' software.

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

Assessment Methodology: Project (20%), Assignment Programs (25%), Practical (25%), Internal Examinations (30%)

References:

1. Daniel, W. W. (2018). Biostatistics: A foundation for analysis in the health sciences (11th ed.). John Wiley & Sons.
2. Armitage, P., Berry, G., & Matthews, J. N. S. (2001). Statistical methods in medical research (4th ed.). Wiley-Blackwell.
3. Rosner, B. (2015). Fundamentals of biostatistics (8th ed.). Nelson Education.
4. Pagano, M., & Gauvreau, K. (2022). Principles of biostatistics (3rd ed.). Chapman & Hall/CRC.
5. Forthofer, R. N., & Lee, E. (2014). Introduction to biostatistics (1st ed.). Academic Press.
6. Dutta, A. K. (2006). Basic biostatistics and its applications (1st ed.). New Central Book Agency.

e-Resources:

- Chandan K. Reddy, Charu C. Aggarwal, “Healthcare Data Analytics,” Chapman & Hall, 2023
- https://www.coursera.org/learn/healthcare-analytics-essentials,“Healthcare Analytics Essentials,” Prof Martin Kohn, Northeastern University.
- Health Care Data Analytics by Digital Health and Informatics, https://www.youtube.com/playlist?list=PLtkf1CzQAYcE6Ob6Yv6PLFQFIhvR7nWl8
- https://onlinecourses.swayam2.ac.in/ntr25_ed73/preview, Data Analytics, Prof. Chandan Chakraborty, National Institute of Technical Teachers Training and Research, Kolkata

CO	Description of CO	PO	PSO
CO1	Explain fundamental concepts of probability, statistical parameters, and coding systems in healthcare data (ICD, LOINC, DICOM).	-	-
CO2	Analyze healthcare datasets using statistical tests, p-values, chi-square tests, and hypothesis testing with R/Python.	PO2, PO3	PSO2(3) PSO3(3)
CO3	Apply regression and correlation analysis to healthcare data for predictive modeling and interpretation.	PO3, PO5	PSO2(3) PSO3(3)
CO4	Conduct meta-analysis, ANOVA, and interpret experimental and clinical study results for informed decision-making.	PO3, PO6, PO9	PSO2(3) PSO3(3)
CO5	Implement data analytics projects on real-world healthcare datasets using R/Python to generate actionable insights.	PO3, PO5, PO10, PO11	PSO2(3) PSO3(3)

BM25C07	Devices and Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

To understand and analyse the fundamental characteristics and applications of semiconductor devices such as diodes, BJTs, JFETs, MOSFETs, and SCRs through hands-on experiments and simulations.

List of Experiments

1. Testing of electronic components (Resistors, Capacitors, PN Junction diode, Zener Diode, BJT, FET….) using multimeter and study of DSO.
2. Characteristics of PN Junction diode.
3. Characteristics of Zener diode.
4. Characteristics of LED
5. Clipper and Clamper circuits.
6. Simulate, investigate and compare the various biasing circuits of BJT amplifier.
7. Characteristics of a transistor connected in Common Base (CB) configuration and calculate current gain, input and output resistance.
8. Characteristics of a transistor connected in Common Emitter (CE) configuration and calculate current gain, input and output resistance.
9. Obtain the output waveforms and determine ripple factor of a Half Wave Rectifier with and without filter
10. Obtain the output waveforms and determine ripple factor of a Full Wave Rectifier with and without filter
11. Drain and Transfer characteristics of JFET

Specific Activity:

- Design and develop a power supply circuit.

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

Assessment Methodology: Project (30%), Practical (40%), Internal Examinations (30%)

TOTAL : 60 PERIODS

References:

1. Boylestad, R. L., & Nashelsky, L. (2014). Electronic devices and circuit theory (11th ed.). Pearson Prentice Hall.
2. Bhattacharya, B., & Sharma, S. (2014). Solid state electronic devices (2nd ed.). Oxford University Press.
3. Sedha, R. S. (2010). A textbook of electronic devices and circuits (1st ed.). S. Chand Publications.
4. Bell, D. A. (2008). Electronic devices and circuits (5th ed.). Oxford University Press.
5. Salivahanan, S., & Suresh Kumar, N. (2022). Electronic devices and circuits (5th ed.). McGraw Hill.

CO	Description of CO	PO	PSO
CO1	Demonstrate and analyze the characteristics of PN junction diodes, Zener diodes, and light-dependent devices through experiments.	PO2 PO3	PSO2(3) PSO3(3)
CO2	Analyze transistor characteristics in CB and CE configurations	PO2 PO3	PSO2(3) PSO3(3)
CO3	Simulate, investigate, and compare BJT biasing circuits.	PO2, PO4 PO5	PSO2(3) PSO3(3)
CO4	Design and implement rectifier circuits and power supplies (linear and SMPS) to understand practical electronic applications.	PO2, PO3, PO5, PO11	PSO2(3) PSO3(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)

TOTAL : 30 PERIODS

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

MA25C06	Probability and Random Processes	L	T	P	C
		3	1	0	4

Course Objectives: The objectives of the course are to introduce concepts about random variables and random processes to compute probabilities and simulate stochastic model and analyse system responses.

Unit I Probability and Random Variables **12**

Probability axioms, Conditional probability, Total probability, Baye‘s theorem - Discrete and continuous random variables, Moments, Moment generating functions.

Activities: R programming to calculate conditional probabilities, the generation of random variables. Solving Competitive Examination questions

Unit II Standard Distributions **12**

Discrete distributions: Binomial, Poisson, Geometric distributions; Continuous distributions: Uniform, Exponential, Normal distributions - Functions of Random variables

Activities: Identification of industrial applications that follow the Binomial distribution, Poisson distribution, Gaussian distribution and describe their behavior and solving Competitive Examination questions.

Unit III Two-Dimensional Random Variables **12**

Joint distributions, Marginal and conditional distributions; Covariance, Correlation and Linear regression. Transformation of random variables; Central limit theorem (for independent and identically distributed random variables).

Activities: Fitting a linear regression model to for real world engineering problems and solving Competitive Examination questions

Unit IV Stochastic Processes **12**

Classification, Stationary processes, Wide sense and strict sense stationary processes; Poisson process, Markov chain, Limiting distribution, Markov process.

Activities: Apply concepts of Markov chain and Poisson process to model real-life systems like queues and random events over time using open-source software and solving Competitive Examination questions

Unit V Correlation, Spectral Densities and Linear Time Invariant System **12**

Auto correlation, Cross correlation, Properties; Power spectral density, Cross spectral density, Properties. Linear time invariant system, System transfer function, Linear systems with random inputs; Auto correlation and cross correlation functions of input and output.

Activities: Create a noisy sine wave, find its Autocorrelation, and plot to see how the signal relates to itself, Use open-source software to construct the system and solving Competitive Examination questions.

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

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

TOTAL : 60 PERIODS

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.

E-resources:

1. https://ocw.mit.edu/courses/6-041sc-probabilistic-systems-analysis-and-applied-probability-fall-2013/
2. https://nptel.ac.in/courses/108103112.
3. https://www.perlego.com/book/2773338/probability-random-variables-and-random-processes-theory-and-signal-processing-applications-pdf
4. https://www.atmos.albany.edu/facstaff/timm/ATM315spring14/R/IPSUR.pdf

	CO Description	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.	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	Analyse spectral properties of random signals, autocorrelation, cross-correlation and spectral densities.	PO2(3)	PSO2(2),
CO5	Examine linear time invariant systems with random inputs using their transfer function	PO2(3) PO5(3)	PSO2(2)

BM25C08	Biomedical Instrumentation	L	T	P	C
		3	0	0	3

Course Objective:

To understand the origin of various biological signals and electrode configurations specific to bio-potential measurements and understand the characteristics of Bio signals and apply the concepts in designing of bio amplifiers and to explain the different techniques used for measurement of non-electrical bio- parameters.

Unit I Biosignal Generation, Characteristics and Electrode Configurations 9

Origin of bio potential and its propagation. Bio signals characteristics- Frequency and amplitude ranges. Electrode-electrolyte interface, electrode–skin interface impedance, polarization effects of electrode – non-polarizable electrodes. Unipolar and bipolar configuration, classification of electrodes, carbon nanotube, platinum Electrodes.

Unit II Bioelectrical Signal Measurement 9

ECG-frequency and amplitude ranges – Einthoven's triangle, ECG system -standard 12 lead system. EEG 10-20 electrode configuration and EEG system, unipolar, bipolar and average mode. EMG– unipolar and bipolar mode. EMG - Electrode configuration and EMG system, ERG, EOG, PCG.

Unit III Bio amplifiers 9

Need for bio-amplifier - Differential bio-amplifier – Single ended amplifier - Band pass filtering, isolation amplifiers – transformer and optical isolation - isolated DC amplifier and AC carrier amplifier. Chopper amplifier. Frequent artifacts and removal.

Unit IV Measurement of Nonelectrical Parameters 9

Temperature, respiration rate and pulse rate measurements. Blood Pressure - indirect methods: auscultatory method, Oscillo metric method, direct methods: electronic manometer, Pressure amplifiers - systolic, diastolic, mean detector circuit.

Unit V Blood Flow Measurement 9

Electromagnetic and ultrasound blood flow measurements,

Cardiac Output Measurement: Indicator dilution, thermal dilution and dye dilution method. Blood cell counter.

Specific Activity:

- Design and development of ECG amplifier circuit.

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%).

TOTAL : 45 PERIODS

References:

1. Webster, J. G. (2021). Medical instrumentation: Application and design (5th ed.). John Wiley & Sons.
2. Cromwell, L. (2026). Biomedical instrumentation and measurement (2nd ed.). Prentice Hall of India.
3. Geddes, L. A., & Baker, L. E. (2008). Principles of applied biomedical instrumentation (3rd ed.).

4. Kutz, M. (2003). Standard handbook of biomedical engineering and design. McGraw Hill.
5. Khandpur, R. S. (2024). Handbook of biomedical instrumentation (3rd ed.). Tata McGraw Hill.
6. Bronzino, J., & Peterson, D. R. (2015). Handbook of biomedical engineering (4th ed.). CRC Press.

CO	Description of CO	PO	PSO
CO1	Explain the origin, characteristics, and propagation of various biological signals and electrode configurations.	-	-
CO2	Analyze ECG, EEG, EMG, ERG, EOG, and PCG signals using appropriate electrode configurations and measurement techniques.	PO2,	PSO1(3) PSO2(3)
CO3	Design and implement bio amplifiers including differential, single-ended, chopper, and isolation amplifiers for accurate signal acquisition.	PO3, PO4	PSO1(3) PSO2(3)
CO4	Measure and analyze non-electrical bio-parameters.	PO3 PO4	PSO1(3) PSO2(3)
CO5	Design and Implement bio amplifiers in simulation tools	PO5, PO8, PO9, PO10, PO11	PSO1(3) PSO2(3)

BM25C09	Analog and Digital Integrated Circuits	L	T	P	C
		3	0	0	3

Course Objective:

The student should be made to study the circuit configuration and implement practical applications of linear integrated circuits and understand the concept of application of ADC and DAC in real time systems and PhaseLocked Loop with applications. Study of basic gates and combinational logic circuits and design of various combinational digital circuits using logic gates bring out the analysis and design procedures for synchronous and asynchronous sequential circuits.

Unit I Operational Amplifier **9**

Ideal characteristics, Performance parameters, Linear and nonlinear Circuits and their analysis - voltage follower, Inverting amplifier, Non-inverting Amplifiers, Differentiator, Integrator, Voltage to Current converter, Instrumentation amplifier, Low pass, High pass filter and band pass filters, Comparator, Multivibrator and Schmitt trigger, Triangular wave generator.

Unit II Digital to analog converters and PLL **9**

Analog switches, High speed sample and hold circuit and IC's, Types of D/A converter - Weighted resistor, R-2R ladder DAC, D/A Accuracy and Resolution. Analog to Digital Converters A/D converter - Flash, Dual slope, Successive approximation, A/D Accuracy and Resolution. Voltage controlled oscillator, PLL- Closed loop analysis of PLL, Frequency multiplication/ division, FSK demodulator

Unit III Basic Gates Combinational Logic Circuits **9**

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, 84-2-1, 2421, Excess 3, Biquinary, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Min terms and Maxterms, Karnaugh map and Tabulation methods. Logic families - TTL, MOS, CMOS.

Unit IV Combinational Logic Circuits **9**

Problem formulation and design of combinational circuits - Code-Converters, Half and Full Adders,Binary Parallel Adder – Carry look ahead Adder, BCD Adder, Magnitude Comparator, Decoder, Encoder, Priority Encoder, Mux / Demux, ROM, PLA and PAL.

Unit V Sequential Logic Circuits **9**

Flip flops – SR, JK, T, D, Master / Slave FF, Triggering of FF, Analysis and design of clocked sequential circuits – state minimization, state assignment, circuit implementation. Counters, RippleCounters, Ring Counters. Types of Registers, Serial In – Serial Out, Serial In – Parallel out, ParallelIn –Serial Out, Parallel In – Parallel Out, Universal Shift Register.

Specific Activity:

- Flipped classroom activity on operational Amplifiers and its Applications,
- Mini Project work on A-D and D-A converter Applications

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

Assessment Methodology: Mini project (30%), Flipped classroom (10%), Solving of GATE questions (20%), Internal Examinations (40%).

TOTAL : 45 PERIODS

References:

1. Franco, S. (2014). Design with operational amplifiers and analog integrated circuits (4th ed.). McGraw Hill Education.
2. Mano, M. M., & Ciletti, M. D. (2018). Digital design (6th ed.). Pearson.
3. Roth, C. H., Kinney, L. L., & H., R. G. (2024). Fundamentals of logic design. Cengage India Private Limited. (4th edition)
4. Gray, P. R., & Meyer, R. G. (2009). Analysis and design of analog integrated circuits (5th ed.). Wiley International.
5. Gayakwad, R. A. (2015). Op-amp and linear ICs (4th ed.). Prentice Hall.
6. Taub, H., & Schilling, D. L. (2017). Digital integrated electronics. McGraw Hill.
7. Coughlin, R. F., & Driscoll, F. F. (2016). Operational amplifiers and linear integrated circuits. Prentice Hall.
8. Floyd, T. L. (2021). Digital fundamentals (4th ed.). Pearson Education.
9. Wakerly, J. F. (2018). Digital design: Principles and practices (5th ed.). Pearson Education.

e-Resources

- https://nptel.ac.in/courses/117103064
- https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ee157
- https://ae-iitr.vlabs.ac.in/

CO	Description of CO	PO	PSO
CO1	Explain the characteristics, performance parameters, and applications of operational amplifiers in linear and nonlinear circuits.		-
CO2	Design and analyze circuits using ADCs, DACs, and Phase Locked Loops (PLL) for real-time system applications.	PO2, PO3	PSO1(3) PSO2(3)
CO3	Apply knowledge of basic gates, Boolean algebra, number systems, and logic families to design combinational and sequential circuits including flip-flops, counters, and registers.	PO2, PO3, PO4	PSO1(3) PSO2(3)
CO4	Develop practical applications through flipped classroom activities and mini-projects on operational amplifiers, ADCs, and DACs.	PO3, PO5, PO9	PSO1(3) PSO2(3)

BM25C10	Biocontrol System	L	T	P	C
		3	0	0	3

Course Objective:

To present a clear exposition of the classical methods of control engineering and to describe physical system modeling, and basic principles of frequency and time domain design techniques. To teach the practical control system design with realistic system specifications and to provide knowledge of physiological control system concept and design.

Unit I Introduction to Control Systems **9**

Block diagram of control system – Open loop and closed loop – Applications and scope. Introduction to Physiological control systems- Illustration, Linear models of physiological systems, Difference between engineering and physiological control systems.

Unit II Mathematical Modeling **9**

electrical and mechanical systems – Equivalence between the elements of different types of systems, Mathematical Modeling of systems, Block diagram and signal flow graph representation of systems – reduction of block diagram and signal flow graph.

Unit III Time Domain Response and Stability Analysis **9**

Step and impulse responses of first order systems, step responses of second order systems – time domain specifications of first and second order systems – steady state error constants. Controllers – P, PI, PID controllers. Concept and definition, Poles, Zeros, Order and Type of systems, Routh- Hurwitz criteria of stability, Root locus technique – construction of root locus and study of stability

Unit IV Frequency Response Analysis **9**

specifications – Polar plots – Bode plots – Nyquist plot – Nyquist stability criterion, closed loop stability – Constant M and N circles – Nichol‘s chart. Stability analysis in frequency domain.

Unit V Biological Control System Analysis **9**

Model development of Cardiovascular system- Heart model-circulatory model, Pulmonary mechanics- Interaction of Pulmonary and Cardiovascular models, Regulation of cardiac output, steady state analysis of muscle stretch reflex action, transient response analysis of neuromuscular reflex model action, frequency response of circulatory control model, Stability analysis of Pupillary light reflex.

Specific Activity:

- Design of lung model using Simulation software (MATLAB).
- Modeling of Cardiac output regulation using Simulation software (CVSIM/MATLAB/etc..)

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

Assessment Methodology: Modelling using software (30%), Solving of GATE questions (30%), Internal Examinations (40%).

TOTAL : 45 PERIODS

References:

1. Nagarath, J., & Gopal, M. (2021). Control systems engineering. New Age International Publishers.(7th ed)
2. Khoo, M. C. K. (2018). Physiological control systems. IEEE Press; Prentice Hall India. (2nd ed)

3. Salivahanan, S., Rengaraj, R., & Venkatakrishnan, G. R. (2017). Control systems engineering. Pearson Education India. (1st ed)
4. Kuo, B. C. (2015). Automatic control systems. Prentice Hall of India.
5. Enderle, J., Blanchard, S., & Bronzino, J. (2005). Introduction to biomedical engineering (2nd ed.). Academic Press.
6. Ogata, K., & Yang, Y. (2002). Modern control engineering (Vol. 4). Prentice-Hall.
7. Dorf, R. C., & Bishop, R. H. (2021). Modern control systems. Pearson. (14th ed)

e-Resources:

- https://nptel.ac.in/courses/108/101/108101037/
- https://nptel.ac.in/content/storage2/courses/112104158/lecture14.pdf
- https://nptel.ac.in/content/storage2/courses/112104158/lecture16.pdf
- https://nptel.ac.in/content/storage2/courses/112104158/lecture17.pdf

CO	Description of CO	PO	PSO
CO1	Explain the fundamental concepts of control systems, including open-loop and closed-loop systems, block diagrams, and physiological control system models.	-	-
CO2	Develop mathematical models of electrical, mechanical, and physiological systems and represent them using block diagrams and signal flow graphs.	PO2, PO3	PSO1(3) PSO2(3)
CO3	Analyze time-domain and frequency-domain responses of control systems, including stability analysis.	PO3, PO4	PSO1(3) PSO2(3)
CO4	Apply simulation tools (MATLAB, CVSIM) to design and analyze physiological control models such as lung dynamics and cardiac output regulation.	PO3, PO5, PO9 PO11	PSO1(3) PSO2(3)

BM25C11	Medical Ethics and Regulatory Standards	L	T	P	C
		3	0	0	3

Course Objective:

Introduction of Medical ethics, Bioethics and professional ethics and learn what qualifies a product as a medical device and understand why medical devices are regulated and who regulates them. Examine the journey to bring a device to market as a manufacturer, importer or distributor

Unit I Medical Ethics and Data Standards in Healthcare **9**

Definition of Medical ethics, Scope of ethics in medicine; Bioethics and Medical ethics - Theories, Deontology & Utilitarianism, Non- Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice; Ethical committee- its members and functions; Evidence Based Medicine. Evolution of Medical Standards; Terminology, Content, Transport and Privacy and Security Standards - HL7 – FHIR - DICOM – LOINC – ICD11 – MeSH – SNOMED – UMLS – HIPPA; International scenario - IEEE, IEC, CEN, FDA, and CE; National scenario - MDR 2017, BIS and CDSCO.

Unit II Medical Device Standards 9

Bio compatibility standards - ISO 10993, General requirements for basic safety & essential performance of medical equipment. IEC 60601 standards -General requirements for electrical medical devices, Collateral Standards IEC 60601-1-XX; Standards – 60601-2 –XX; EMI, EMC and EMS; Pseudo Collateral standards – IEC 62304, IEC 82304 and IEC 62366; Risk Management 14971, IT and Audio – IEC 62368 and IEC 60950; Component's standards - Primary and Secondary Batteries, Fuses, Optocouplers, Plastics and Y-cap.

Unit III Hospital Accreditation and Safety Standards **9**

National Accreditation Board for Hospitals (NABH 6th edition Jan 2025) – Patient centred and Management centred; NABH (Digital standards); Handling Biomedical waste and disposal as per standards; NBC and NEC – 2023 standards applicable to hospitals, Electrical and Life Safety Standards, Protecting Occupants, Protecting the Hospital from Fire, Smoke, and Heat, Systems for Extinguishing Fires; Environment of Care Standards; AERB Compliance – Radiation protection AE(RP)R-2004, Safety Code AE/RF-MED/SC-3.

Unit IV ICMED 13485 Plus **9**

ISO 9001, ISO 13485, ICMED 9000 scheme, ICMED 13485 scheme and Indian Certification of Medical Devices (ICMED) 13485 Plus - Quality Management Systems - Management Responsibility - Resource Management - Product Realization - Measurement, Analysis and Improvement; ISO 14001, ISO 45001 and e waste management and disposal, R2 certification. Startups – State and national initiatives - TRLs and applicable standards for each TRL.

Unit V Medical Equipment Safety Standards **9**

ISO/IEC 17025:2017 standard – Scope, Normative references, Terms and definitions, General requirements, Structural requirements, Resource, Process and Management requirements, Internal audit and NABL approval processes and manuals.

Activity:

- Case study on standards and regulatory compliance required for a medical device from design to commercialization / Case study on documentary requirement in biomedical department in a hospital pertaining to NABH standards.

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

Assessment Methodology: Case studies (40%), Group discussion(20%), Internal Examinations (40%).

TOTAL : 45 PERIODS

References:

1. Fisher, J. (2009). Biomedical ethics: A Canadian focus. Oxford University Press Canada.
2. Veatch, R. M. (2011). The basics of bioethics (3rd ed.). Routledge.
3. Joint Commission. (2018). Joint commission accreditation standards for hospitals (6th ed.).

e-RESOURCES:

1. https://www.bis.gov.in
2. https://qcin.org/public/uploads/ckdocs/1668347882.7%20ICMED_%20Section%204B_Certification%20Process%20for%20ICMED%20%2013485%20Plus.pdf
3. https://nabcb.qci.org.in/schemes-for-industry-second/
4. https://www.iso.org/ISO-IEC-17025-testing-and-calibration-laboratories.html
5. https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/standard_review/Standard_review/Isdetails?ID=MjQ5OTA%3D
6. https://www.services.bis.gov.in/php/BIS_2.0/bisconnect/knowyourstandards/Indian_standards/isdetails/MjgwODc=
7. https://portal.nabh.co/images/Standards/NABH%20Hospital%20Accreditation%20Standard%206th%20Edition%20January%202025.pdf
8. https://www.iso.org/standards.html
9. https://www.koitafoundation.org/src/pdf/nabh-digital-health-standards-for-hospital.pdf
10. https://www.intertek.com/medical/regulatory-requirements/iec-60601-1/

CO	Description of CO	PO	PSO
CO1	Explain the fundamental principles of medical ethics, bioethics, and professional ethics, including autonomy, confidentiality, beneficence, and justice.	PO2, PO3	PSO1(3) PSO2(3)
CO2	Analyze healthcare data standards (HL7, FHIR, DICOM, LOINC, ICD11, SNOMED, HIPAA) and understand their role in interoperability, privacy, and security	PO2, PO3	PSO1(3) PSO2(3)
CO3	Evaluate medical device standards, hospital accreditation norms, and regulatory frameworks (ISO 10993, IEC 60601, NABH, MDR, ICMED 13485) for compliance and safety.	PO3, PO4	PSO1(3) PSO2(3)

CO4	Apply knowledge of standards and regulations to implement quality management systems, e-waste management, and compliance procedures in medical device development and healthcare settings.	PO3, PO5, PO9	PSO1(3) PSO2(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/cross-cultural contexts

From Campus to Career: Industry Skills and Global Exam Preparation

(i) Participate in HR interviews using AI tools or peer interviewers, responding to behavioral 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)

TOTAL : 30 PERIODS

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. Interview ology: 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)
CO4	Communicate appropriately in intercultural/cross cultural contexts	PO9(3) PO11(1)	PSO3(3)
CO5	Perform in interviews and competitive exams successfully	PO9(3)	PSO3(1)

BM25C12	Analog and Digital Integrated Circuits Laboratory	L	T	P	C
		0	0	4	2

Course Objective:

Students design digital logic and circuits and to learn the function of different ICs and understand the applications of operation amplifier.

List of Experiments

1. Inverting, non-inverting amplifier and comparator
2. Integrator and Differentiator
3. Design and analysis of active filters using op-amp
4. Schmitt trigger using operational amplifier
5. Instrumentation amplifier using operational amplifier
6. RC and LC oscillators
7. Multivibrators using IC555 Timer
8. Study of logic gates, Half adder and Full adder
9. Encoder and BCD to segment decoders
10. Multiplexer and demultiplexer using digital ICs
11. Universal shift register using flip flops
12. Design of mod-N counter

Activity

- Simulation of Op-amp circuits for various applications using software.

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

Assessment Methodology: Project (30%), Practical (40%), Internal Examinations (30%)

TOTAL : 60 PERIODS

CO	Description of CO	PO	PSO
CO1	Understand and explain the working of operational amplifiers and digital ICs through simulation and practical circuits	-	-
CO2	Design, implement, and analyse analog circuits such as amplifiers, filters, oscillators, and multivibrators using operational amplifiers and timers.	PO3, PO5	PSO2(3) PSO3(3)
CO3	Design and implement combinational and sequential digital circuits including logic gates, adders, decoders, multiplexers, and counters using digital ICs.	PO3, PO4, PO9	PSO2(3) PSO3(3)
CO4	Simulate Op-amp circuits for various applications using software.	PO3, PO5, PO11	PSO2(3) PSO3(3)

MRK Institute of Technology 608 301. Kattumannarkoil.

Dr. K. ANANDAVELU, B.E., M.E., Ph.D.
D.I.S., I.G.C.O.H.S.,M.I.S.T.E.,M.S.E.A (T).,
PRINCIPAL
MRK Institute of Technology
Kattumannarkoil - 608 301.