ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B. Tech. Chemical and Electrochemical Engineering **Regulations:** 2025

Abbreviations:

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

BS – Basic Science (Mathematics, Physics, Chemistry)

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

SD – Skill Development

SL – Self Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP – Total Contact Period(s)

Program Outcomes

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

10. **Management & Finance**: Apply management and economic principles in projects and teamwork.
11. **Lifelong Learning**: Engage in continuous learning, adapt to new technologies, and think critically.

Program Specific Outcomes:

PSO 1: Design, Develop and optimize electrochemical processes for system development with energy efficiency and safety.

PSO 2: Use modern simulation tools and adapt sustainable practices for innovative solutions in electrochemical systems.

PSO 3: Exhibit Research aptitude, work as team and promote sustainable practices.

Semester – I							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	EN25C01	English Essentials – I	T	2-0-0	2	2	HUM
2.	MA25C01	Applied Calculus	T	3-1-0	4	4	BS
3.	UC25H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	HUM
4.	CH25C01	Introduction to Chemical Engineering	T	2-1-0	3	3	ES (PC)
5.	PH25C01	Applied Physics - I	LIT	2-0-2	4	3	BS
6.	CY25C01	Applied Chemistry - I	LIT	2-0-2	4	3	BS
7.	CS25C02	Computer Programming: Python	LIT	2-0-2	4	3	ES (PC)
8.	ME25C04	Makerspace	L	0-0-4	4	2	SD
9.	UC25A01	Life Skills for Engineers – I	---	1-0-2	3	1	HUM
10.	UC25A02	Physical Education – I	---	0-0-4	4	1	HUM
11.		NCC / NSS / NSO/ YRC	---	---	---	---	---
Total Credits					**33**	**23**	

Semester – II							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C02	Linear Algebra	T	3-1-0	4	4	BS
2.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	HUM
3.	CY25C04	Applied Chemistry (Tech) – II	T	2-0-0	2	2	BS
4.	PH25C06	Applied Physics (Tech) – II	T	2-1-0	3	3	BS
5.	EE25C01	Basic Electrical and Electronics Engineering	T	3-0-0	3	3	ES (G)
6.	EL25204	Introduction to Electrochemical Engineering	T	3-0-0	3	3	ES (PC)
7.	ME25C01	Engineering Drawing	LIT	2-0-4	6	4	ES (G)
8.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
9.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
10.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
11.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
12.		Foreign Language^	LIT	1-0-2	3	1	HUM
			Total Credits		**35**	**27**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C09	Computational Differential Equations	T	3-1-0	4	4	BS
2.	CH25201	Chemical Process Calculations	T	3-1-0	4	4	ES (PC)
3.	EL25C01	Chemical Engineering Thermodynamics	T	3-1-0	4	4	ES (PC)
4.	EL25302	Principles of Electrochemistry	T	3-0-0	3	3	ES (PC)
5.	EL25303	Fluid and Solid Operations	T	3-1-0	4	4	ES (PC)
6.	EL25304	Fluid and Solid Operations 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		**25**	**22**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	EL25402	Electrodics and Electrocatalysis	T	3-0-0	3	3	ES (PC)
2.	EL25C02	Mass Transfer	T	3-0-0	3	3	ES (PC)
3.	EL25403	Chemical Reaction Engineering	T	3-1-0	4	4	ES (PC)
4.	CH25C06	Heat Transfer	LIT	3-0-2	5	4	ES (PC)
5.	EL25404	Instrumental Methods of Analysis	T	3-0-0	3	3	ES (PC)
6.	CH25C07	Introduction to Standards in Chemical Engineering	T	1-0-0	1	1	ES (PC)
7.	__	Industry Oriented Course - I	LIT	1-0-2	3	1	SD
8.	__	Skill Development Course- I	LIT	1-0-2	3	2	SD
9.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
10.	EL25405	Electrochemistry Laboratory	L	0-0-4	4	2	ES (PC)
			Total Credits		**31**	**24**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Electrochemical Reaction Engineering	T	3-0-0	3	3	ES (PC)
2.		Programme Elective I	T	3-0-0	3	3	ES (PE)
3.		Programme Elective II	T	3-0-0	3	3	ES (PE)
4.		Electrochemical Energy Conversion and Storage	T	3-0-0	3	3	ES (PC)
5.		Industry Oriented Course - II	T	1-0-0	1	1	SD
6.		Skill Development Course - II	T	1-0-2	3	2	SD
7.		Process Dynamics and Control	LIT	3-0-2	5	4	ES (PC)
8.		Heat and Mass Transfer Lab	L	0-0-4	4	2	ES (PC)
			Total Credits		**25**	**21**	
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.		Corrosion Science and Engineering	T	3-0-0	3	3	ES (PC)
2.		Industrial Metal Finishing	T	3-0-0	3	3	ES (PC)
3.		Transport Phenomena	T	3-0-0	3	3	ES (PC)
4.		Professional Elective III	T	3-0-0	3	3	ES (PE)
5.		Open Elective	T	3-0-0	3	3	ES (OE)
6.		Self-Learning Course	---	---	0	1	SL
7.		Skill Based Course – III	LIT	1-0-2	3	2	SD
8.		Chemical and Electrochemical Reaction Engineering Laboratory	L	0-0-4	4	2	ES (PC)
Total Credits					**22**	**20**	
For Honours Degree							
1.		Capstone Design Project- Level II	CDP	0-0-12	12	6	SD
(OR)							
1.		Honours Elective – III	T	3-0-0	3	3	
2.		Honours Elective – IV	T	3-0-0	3	3	
for Minor Degree							
1.		Minor Elective – III	T	3-0-0	3	3	
2.		Minor Elective – IV	T	3-0-0	3	3	

Semester – VII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		Engineering Entrepreneurship Development	T	2-0-2	4	3	HUM
2.		Climate Change and Sustainability	T	2-0-0	2	2	HUM
3.		Batteries for Electric Vehicles	T	3-0-0	3	3	ES (PC)
4.		Programme Elective IV	T	3-0-0	3	3	ES (PE)
5.		Programme Elective V	T	3-0-0	3	3	ES (PE)
6.		Project Management	T	2-0-0	2	2	HUM
7.		Internship / Industry Project	L	0-0-2	2	1	SD
8.		Corrosion and Metal Finishing Laboratory	L	0-0-4	4	2	ES (PC)
9.		Computer Applications in Chemical Engineering Laboratory	L	0-0-4	4	2	ES (PC)
Total Credits					**27**	**21**	

For Honours Degree							
1.		Capstone Design Project – Level III	CDP	0-0-12	12	6	SD
(OR)							
1.		Honours Elective – V	T	3-0-0	3	3	
2.		Honours Elective – VI	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – V	T	3-0-0	3	3	
2.		Minor Elective – VI	T	3-0-0	3	3	

Semester – VIII

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

Total Credits of the Programme: 166

PROGRAMME ELECTIVE COURSES – STREAMS

Computational Methods	Energy Technology	Environmental Process Engineering	Electrochemical Technologies	Process Technology
Chemical Process Design	Bioenergy	Air Pollution Engineering	Electrochemical Process Technology	Fertilizer Technology
Optimization of chemical processes	Renewable Energy	Water & Waste Water Treatment	Hydrogen Storage and Fuel Cell	Polymer technology
Process Modelling	Hydrogen	Solid waste management	Advanced Electrochemical Energy Storage Systems	Paint Processing Technology
Machine learning in Chemical Engineering	Electrochemical Engineering	Environmental impact assessment	Cathodic Protection and Electrophoretic Coatings	Rubber and Plastic Technology
Chemical process flow sheeting	Power Plant Engineering	Process Safety Management	Electrometallurgy And Thermics	Nano materials & applications
Computational Fluid Dynamics	Non-Renewable Energy Sources	Risk and HAZOP analysis	Electrochemical Materials Science	Pharmaceutical Technology and Drug Delivery System

Semester I

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

References:

1. Miller, K. Q., & Wahl, S. T. (2023). *Business and Professional Communication: KEYS for Workplace Excellence* (5th ed.). SAGE Publications.

2. Kumar, Sanjay & Pushpalatha. (2018). *English Language and Communication Skills for Engineers*. India: Oxford University Press.
3. Sharma, S., & Mishra, B. (2024). *Communication Skills for Engineers and Scientists* (2nd ed.). PHI Learning.

E-resources:

1. Cambridge English – https://www.cambridgeenglish.org/learning-english/grammar-and-vocabulary/
2. Perfect English Grammar – https://www.perfect-english-grammar.com/
3. British Council – Learn English - https://learnenglish.britishcouncil.org/grammar
4. Speechling – https://speechling.com/
5. mePro by Pearson – https://mepro.pearson.com/
6. TED Talks – https://www.ted.com/

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

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.
2. Ron Larson and David C. Falvo,(2013), Calculus: an Applied Approach. Cengage Learning.
3. Stewart, J., Clegg, D., & Watson, S. (2019). *Calculus: Early transcendentals*.
4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2018). *Thomas' calculus: Early transcendentals*. Pearson.
5. Singh, K. (2019). *Engineering mathematics through applications*. Bloomsbury Publishing.
6. Grewal, B. S. (2012). *Higher engineering mathematics.* Khanna Publishers.

E-resources:

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

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

UC25H01	தமிழர் மரபு	L	T	P	C
		1	0	0	1

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

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

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

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

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

References:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department 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.

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

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

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

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

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

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

References:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department 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.

CH25C01	Introduction to Chemical Engineering	L	T	P	C
		2	1	0	3

Course Objectives:

This course provides a foundational understanding of chemical engineering by introducing students to core. It covers essential topics highlighting their applications in real-world industries. The course also emphasizes the role of chemical engineers.

Overview of chemical Engineering. Introduction to Unit Operations and Processes. Process Flow Sheeting symbols and representation of unit operations, Unit conversions, Mass and Energy conservation equations.

Activity: Virtual demonstration of flow sheeting and symbols petroleum refinery

Basics of fluid flow and flow measurements, Basic Thermodynamics and its application, Principles and Applications of particle Mechanics, Principles and Applications of Heat and Mass transfer. Chemical Kinetics and Reaction Engineering. Introduction to Process Control and symbols (P&ID).

Activity: 1. Virtual demonstration of flow machining devices, size reduction equipment

2. Virtual demonstration of Heat transfer mechanics

Significance of Chemical Engineering in Food, Health, Energy and Environment. Software and applications in chemical industries. Safety in process industries. Few Case studies.

Activity: Report preparation in any process industry

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

Assessment Methodology: Assignments (20%), Quiz (10%), Case Study (20%), Internal Examinations (50%).

References:

1. Pushpavanam, S. *Introduction to chemical engineering*. PHI Learning Pvt. Ltd. 2012.
2. Anderson L. B. and L. A. Wenzel, Introduction to Chemical Engineering, McGraw Hill Publications, 1998.
3. S. K. Ghosal, S. K., Sanyal and S. Datta, Introduction to Chemical Engineering, TMH Book Company, 1998.
4. Badger, Walter Lucius, and Julius T. Banchero. "Introduction to chemical engineering." McGraw-Hill. (1955).

E-Reference:

https://onlinelibrary.wiley.com/doi/book/10.1002/9781119592228

	CO Description	PO	PSO
CO1	Describe the core concepts of Chemical engineering.	---	---
CO2	Apply basic Chemical engineering calculations in the systems.	PO1(3)	PSO1(1)
CO3	Appraise the roles of chemical engineering in various process industries.	PO2(2)	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.

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

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

Activities: Virtual demonstration of thermal stress.

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

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

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

Activities: Virtual demonstration of propagation of EM waves

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

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

Activities: Virtual demonstration of Scanning Transmission Electron Microscope

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

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

Activities: Demonstration of sensors and applications of Lasers

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

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

References:

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

E-resources:

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

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

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

Course Objectives:

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

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

Practical: Analysis of alkalinity, hardness and dissolved oxygen.

Activity: Coagulation of water sample using Alum

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

Practical: Preparation of nanoparticles by Sol-Gel method.

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

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

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

Practical:

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

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

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

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

Activities: Demonstration of battery pack in e-vehicles.

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

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (5%),

Practical (30%), Internal Examinations (40%)

References:

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

E-Resources:

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

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

CS25C02	Computer Programming: Python	L	T	P	C
		2	0	2	3

Course Objectives:

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

Introduction to Python: Problem Solving, Problem Analysis Chart, Developing an Algorithm, Flowchart and Pseudocode, Interactive and Script Mode, Indentation, Comments, Error messages, Variables, Reserved Words, Data Types, Arithmetic operators and expressions, Built-in Functions, Importing from Packages.

Practical: Problem Analysis Chart, Flowchart and Pseudocode Practices. (Minimum three)

Control Structures: if, if-else, nested if, multi-way if-elif statements, while loop, for loop, nested loops, pass statements.

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

Functions: Hiding redundancy, complexity; Parameters, arguments and return values; formal vs actual arguments, named arguments, Recursive & Lambda Functions.

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

Strings & Collections: String Comparison, Formatting, Slicing, Splitting, Stripping, Lists, tuples, and dictionaries, basic list operators, searching and sorting lists; dictionary literals, adding and removing keys, accessing and replacing values.

Practical: String manipulations and operations on lists, tuples, sets, and dictionaries. (Minimum three)

File Operations: Create, Open, Read, Write, Append and Close files. Manipulating directories, OS and Sys modules, reading/writing text and numbers, from/to a file; creating and reading a formatted file (csv, tab-separated, etc.).

Practical: Opening, closing, reading and writing in formatted file format and sort data. (Minimum three)

Packages: Built-in modules, User-Defined modules, Numpy, SciPy, Pandas, Scikit-learn**.**

Practical: Usage of modules and packages to solve problems. (Minimum three), Project (Minimum Two)

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

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

References:

1. Matthes, E. (2019). *Python crash course: A hands-on, project-based introduction to programming* (2nd ed.). No Starch Press.
2. Brown, M. C. (2018). *Python: The complete reference*. McGraw Hill Publishers.
3. Guttag, J. V. (2016). *Introduction to computation and programming using Python: With applications to understanding data*. MIT Press.
4. McKinney, W. (2017). *Python for data analysis: Data wrangling with pandas, NumPy, and IPython*. Shroff/O'Reilly.

E-Resources:

1. Official Python Documentation – https://docs.python.org/3/
2. Python Tutorials – https://www.w3schools.com/python/
3. NumPy – https://numpy.org/doc/
4. SciPy – https://scipy.org/
5. Google's Python class – https://developers.google.com/edu/python/

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

ME25C04	Makerspace	L	T	P	C
		0	0	4	2

Course Objectives:

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

List of Activities

(A). Dis-assembly & Assembly Practices

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

(B). Welding Practices

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

(C). Electrical Wiring Practices

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

(D). Electronics Components / Equipment Practices

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

(E). Contemporary Systems

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

References:

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

Course Outcomes:

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

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

Course Objectives:

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

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

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

Course Objectives:

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

E-resources:

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.

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

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

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

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

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

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

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

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

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

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

References:

1. Friedberg, S. H., Insel, A. J., & Spence, L. E. (2022). *Linear algebra*. Pearson.
2. Lay, D. C., Lay, S. R., & McDonald, J. J. (2020). *Linear algebra and its applications with MATLAB*. Pearson.
3. Bronson, R. (2011). *Schaum's outline of matrix operations*. McGraw-Hill Education.

4. Strang, G., & Thomson, R. (2005). *Linear algebra and its applications*. Brooks/Cole.
5. Lipschutz, S., & Lipson, M. (2009). *Schaum's outline of linear algebra*. McGraw-Hill.
6. Kreyszig, E. (2018). *Advanced engineering mathematics*. Wiley India.

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

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

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

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

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

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

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

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

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

References

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
   கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi – 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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		1	0	0	1

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

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

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

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

Scientific Tamil & Tamil Computing: Development of Scientific Tamil, Tamil computing, Digitalization of Tamil Books, Development of Tamil Software, Tamil Virtual Academy, Tamil Digital Library, Online Tamil Dictionaries, Sorkuvai Project.

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

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

References

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by: 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.

CY25C04	Applied Chemistry (Tech) – II	L	T	P	C
		2	0	0	2

Course Objectives:

- To impart knowledge on chemical principles used in various fields of textile technology.
- To build a foundation in applied chemistry relevant to materials, interfaces, and surface technologies.

Interface and Colloids: Interface region, Interface control, Emulsion and Foams, Surfactant action.

Activities: Demonstration of oil-water interfaces, Formation of micelles.

Oils, Fats and Soaps: Types of oils, Properties of oils, Fats – classification, Soaps and detergents.

Activities: Seminar on the saponification of edible, non-edible and essential oils.

Lubricants: Mechanism of lubrication, Preparation of Petro lubes, Characteristics, Semisolid lubricant, Solid lubricants.

Activities: Virtual demonstration of lubrication, Assignment on the lubricants used in automotive engines.

Adhesives: Adhesive action, Classification of adhesives, Factors influencing adhesive action, Synthetic adhesives.

Activities: Adherence of liquids on surfaces (Flipped Class sessions).

Colourants: Theory of colour and constitution, Classification of dyes based on application, Chemistry and synthesis of dyes.

Activities: Study of bonding of dyes with fabric (Flipped Class sessions).

Chemical Auxiliaries: Functions, Classification, Preparation, Estimation using Iodometry, Permanganometry.

Activities: Estimation of available chlorine, Determination of strength of hydrogen peroxide, potential hazards of auxiliaries.

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

Assessment Methodology: Quiz (5%), Assignments (20%), Flipped Class (15%), Virtual Practice (10%), Internal Examinations (50%)

References:

1. Jain, J., & Jain, S. (2015). Engineering Chemistry. Dhanpat Rai Publishing Company.

2. Dara, S. S., & Umare, S. S. (2024). A textbook of Engineering Chemistry. S. Chand & Company Ltd.
3. Sharma, B. K. (2014). Industrial Chemistry. Goel Publishing House, Krishna Prakashan Media (P) Ltd.
4. Puri, B. R., Sharma, L. R., & Pathania, S. (2020). Principles of Physical Chemistry. Vishal Publishing Co.

	Description of CO	**PO**	**PSO1**
CO1	Explain the applications of chemistry in the field of textile technology.	---	
CO2	Apply chemistry concepts in various textile applications.	PO1(3)	PSO1(2)
CO3	Analyse the systems and interpret data from the virtual studies in the field of textile technology.	PO2(2)	PSO2(2) PSO3(1)

PH25C06	Applied Physics (Tech) – II	L	T	P	C
		2	1	0	3

Course Objectives:

- To impart knowledge on physics concepts and explore the potential applications in the fields of engineering and technology.

Thermal Physics: Thermal Expansion- Thermal stress- Thermal resistance - Heat transfer- Thermal conductivity (Virtual demo) - Lee's disc method - Forbe's method - conduction through compound media –thermo-electric power.

Activities: Measurement of thermal conductivity of bad conductors.

Dielectric Properties: Dielectric- ferroelectric materials - Internal field – Clausius Mosotti equation – dielectric loss – Piezo, Pyro electric materials – Applications

Activities: Virtual demonstration of Piezoelectric sensor.

Optical Properties: Classification of optical materials – Luminescence-Phosphors - Polarization – Optical anisotropy - Optical processes in semiconductors – LED characteristics (Virtual demo)

Activities: Virtual demonstration of LED Characteristics

New Engineering Materials: Ceramics –Composites - fibre reinforced plastics -fibre reinforced metals – Shape memory alloys (Virtual Demo) – Biomaterials – hydroxyapatite – Bio-sensors – Polymer semiconductors – CNT (Carbon Nano Tubes)

Activities: Virtual demonstration of 3D structure of CNTs.-

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

Assessment Methodology: Quiz (10%), Assignments (30%), Flipped Class (10%), Internal Examinations (50%)

References:

1. Raghavan, V. (2007). *Materials science and engineering*. Prentice Hall of India.
2. Brijlal, & Subramaniyan, N. (2018). *Heat, thermodynamics and statistical physics*. S. Chand.
3. Askeland, D. R. (2010). *Materials science and engineering*. Brooks/Cole.
4. Kasap, S. O. (2007). *Principles of electronic materials and devices*. McGraw-Hill Education.

E-resources:

1. Thermal conductivity -Understanding Thermal Conductivity in Solids - https://youtu.be/VcFqqdGcwrw-
2. Applications of Piezo and pyro electric materials -NDLI: Lecture 40- Applications of Piezoelectric and Pyroelectric Materials
3. White LED_ https://archive.nptel.ac.in/courses/108/108/108108122/
4. Shape memory alloys: https://nescacademy.nasa.gov/video/00a31561480547248033a1c2df6f87831d

	Description of CO	PO	PSO
CO1	Explain the concepts of physics in technology stream.	---	
CO2	Apply appropriate techniques in physics to solve engineering problems.	PO1(3)	PSO1(3)
CO3	Analyse physical systems and interpret data from the virtual studies in the core branches in technology streams.	PO2(2)	PSO1(2)

EE25C01	Basic Electrical and Electronics Engineering	L	T	P	C
		3	0	0	3

Course Objectives:

- To impart foundational knowledge in principles and applications of electrical and electronics engineering.

DC Fundamentals: Current and Voltage sources, Resistance, Inductance and Capacitance; Ohm's law, Kirchhoff's law, Series parallel combination of R, L and C components, Voltage Divider and Current Divider Rules.

Activities: Virtual Demonstration of electrical laws & circuits, Hands-on Breadboarding, Solving GATE questions.

AC Fundamentals: Faraday's Laws of Electro-magnetic Induction, Definition of Self and Mutual Inductances, Generation of sinusoidal voltage, Instantaneous & RMS values of sinusoidal signals, Introduction to 3-phase systems, Electrical Safety, Fuses and Earthing.

Activities: Virtual Demonstration of electromagnetic induction, Measurement of instantaneous and RMS values of AC signals, Solving GATE questions.

Electric Machines: DC Machines, Transformers, Star and delta Connections, Three phase Induction motors, Synchronous Generators, Single Phase Induction Motors, Stepper Motor, Universal Motor and BLDC motor.

Activities: Virtual demonstration of step-up and step-down transformers, Virtual working models of Universal and BLDC motors, Solving GATE questions.

Semiconductor Devices: PN junction diodes, Zener Diode, Voltage regulator, BJT & FET Transistors, Timers, Operational Amplifiers.

Activities: Virtual demonstration of V-I characteristics of PN junction and Zener diodes using simulation, inverting/non-inverting amplifiers, Solving GATE questions.

Digital Electronics: Boolean algebra, Basic and Universal Gates, adders, multiplexers, demultiplexers and flip-flops.

Activity: Online logic gate simulators, Solving GATE questions.

Microcontrollers: Introduction, Architecture, Potential Applications.

Activities: Physical demonstration of a microcontroller and online simulation of microcontroller.

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

Assessment Methodology: Quiz (5%), Assignments (25%), GATE Questions (20%), Internal Examinations (50%)

References:

1. Del Toro, V. (2022). *Electrical engineering fundamentals*. Pearson Education.

2. Hambley, A. R. (Year). *Electrical engineering: Principles and applications* (Edition if known). Publisher.
   (Note: Please provide the year and edition for complete citation)
3. Mehta, V. K., & Mehta, R. (2006). *Principles of electrical engineering and electronics*. S. Chand Publishing.

E-resources:

1. https://archive.nptel.ac.in/courses/108/106/108106172/
2. Circuit Simulator – https://www.falstad.com/circuit/

	Description of CO	**PO**	**PSO**
CO1	Understand and explain basic electrical and electronic concepts.	---	
CO2	Apply and analyse electrical circuits in real-time applications.	PO1 (3) PO2 (1)	PSO1(2)
CO3	Identify and utilise key electronic devices used in engineering applications	PO2 (2)	PSO1(2)

EL25202	Introduction to Electrochemical Engineering	L	T	P	C
		3	0	0	3

Course Objectives:

To impart the fundamental knowledge of electrochemical engineering for the electrochemical process and electrode design.

The scope and history of electrochemical engineering: Carl Wagner and the Beginning of Electrochemical Engineering Science, Electrochemistry and Electrochemical Engineering Science, Developments since the Mid-1960s, Present-day scenario.

Activity: Report preparation of history of electrochemical engineering.

Basic principles and laws in electrochemistry: Stoichiometry of Electrochemical Reactions, Faraday's Law, Production Rates and Current Densities, Current and Energy Efficiency, Ohm's Law and Electrolyte Conductivities, Parallel Circuits and Cells with Electrolytic Bypass and Kirchhoff's Rules.

Activity: Demonstration of different laws and electrical circuits.

Electrochemical thermodynamics: Equilibrium Cell Potential and Gibbs Energy, Electrode Potentials, Reference Electrodes, Voltage Series, Redox Schemes, Reaction Enthalpy, Reaction Entropy.

Activity: Demonstration of electrode potential measurement.

Electrochemical cell and plant engineering: Materials Choice and Corrosion Problems: Metals & Carbons. Electrode materials: Stainless steel, Nickel, Lead, Titanium, Noble metals, Carbon.

Activity: List out various electrodes used in the different industry.

Electrode design: Gas evolving electrodes, Gas Consuming Electrodes, Gas Diffusion Electrode. Separators: Membranes and Diaphragm.

Activity: Demonstration of various electrodes.

Industrial Electrodes: Chlorine-Evolving Electrodes, Electro catalysis and Selectivity of Anodic Chlorine Evolution at RuO_2-Anodes, Oxygen Evolving Anodes, Hydrogen Evolving Cathodes

Activity: Plant visit to an electrochemical process industry.

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

Assessment Methodology: Quiz (10%), Assignments (20%), Demonstration (20%), Internal Examinations (50%)

References:

1. Wendt, H., &Kreysa, G. (1999). *Electrochemical engineering: Science and*

technology in chemical and other industries. Springer.
2. Fletcher, D., & Walsh, F. C. (n.d.). *Industrial electrochemistry* (2nd ed.). Springer Science. *(Note: No publication year provided; "n.d." means "no date." Please update if known.)*
3. Mantell, C. L. (n.d.). *Industrial electrochemistry*. McGraw-Hill Chemical Engineering Series. *(Year not given — please provide if available.)*
4. Fletcher, D. (1984). *Industrial electrochemistry* (1st ed.). Springer. https://doi.org/10.1007/978-94-017-1872-1
5. Breitkopf, C., & Swider-Lyons, K. (Eds.). (2017). *Springer handbook of electrochemical energy*. Springer.
6. Newman, J., & Thomas-Alyea, K. E. (2012). *Electrochemical systems* (4th ed.). Wiley-Interscience.

E-Resources:

1. https://ocw.mit.edu/courses/10-626-electrochemical-energy-systems-spring-2014/
2. https://www.youtube.com/results?search_query=mit+electrochemistry
3. https://www.electrochem.org/publications/jes

	Description of CO	PO	PSO
CO1	Explain the history and development of Electro chemical engineering domain.	--	--
CO2	Categorize the basic law involved in electrochemical engineering.	PO1(1) PO2(3)	PSO1(1)
CO3	Develop various electrochemical processes and thermodynamic principles.	PO2(2) PO3(3)	PSO2(1)
CO4	Design the plant and electrodes for the electrochemical engineering process.	PO2(1) PO3(3)	PSO3(1)
CO5	Engage the independent study in the industrial electrodes used in diversified electrochemical industry.	PO6(2) PO11(2)	PSO3(2)

ME25C01	Engineering Drawing	L	T	P	C
		2	0	4	4

Course Objectives:

- To impart knowledge on dimensions and drawing standards.
- To explore the orthographic projection of lines and solids.
- To provide the understanding of orthographic, isometric and perspective views.

Fundamentals: Drawing instruments, Drawing standards (BIS), Lettering in engineering, Sheet layout, elements of dimensioning, Systems of dimensioning. Free hand sketching of 2D & 3D objects, Conics, Ellipse, Parabola and Hyperbola.

Activities: Virtual Demonstration of Conics and Cycloids.

Orthographic Projection: First angle projection, Projection of points, straight lines and planes.

Projection of Solids: Simple Solids, Section of Solids, Development of Surfaces

Activities: Development of models of various solids and virtual demonstration of sectioning, CAD modelling of 2D objects.

Isometric Projection: Isometric Scale, Projection of Simple solids.

Activities: Conversion of 3D into 2D orthographic views, CAD modelling of 3D objects.

Perspective Projection: Simple solids projection

Activities: Virtual demonstration of perspective views.

Project: Development of 2D objects and 3D objects using CAD tools.

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

Assessment Methodology: Project – 10%, Models - 5%, Assignments - 35% and Internal Examinations - 50%

References:

1. Natarajan, K. V. (2025). A Text Book of Engineering Graphics. Dhanalakshmi Publisher.
2. Venugopal, K., & Prabhu Raja, V. (2022). Engineering Drawing + AutoCAD. New Age International Publishers.

E-Resources:

1. **C**AD Software – **https://www.freecadweb.org/**
2. Engineering Drawing and Computer Graphics, Prof. Rajaram Lakkaraju (IIT Kharagpur) – **https://onlinecourses.nptel.ac.in/noc22_me105/preview**

3. MIT Design Handbook: Engineering Drawing and Sketching – **https://ocw.mit.edu/courses/2-007-design-and-manufacturing-i-spring-2009/pages/related-resources/drawing_and_sketching/**

	CO Description	**PO**	**PSO1**
CO1	Explain the advantages of engineering drawing in engineering applications	---	
CO2	Apply the concepts of projections in formulating various solid parts in engineering systems.	PO1(3)	PSO1(2)
CO3	Analyse the various view and interpret the engineering drawings.	PO2(3)	PSO1(2)
CO4	Use CAD tools for creation of various models.	PO3(1)	PSO2(2)
CO5	Critically think and develop innovative models.	PO11(1)	PSO3(1)

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

Course Objectives

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

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

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

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

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

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

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

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

Suggested Activities: SWOT Analysis, Brainstorming and Group discussions.

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

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

References:

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

E-resources:

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

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

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 (3rd ed.). 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)

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)

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)

FOREIGN LANGUAGE^

UC25F01	Deutsch – I	L	T	P	C
		1	0	2	1

Course Objectives:

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

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

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

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

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

Course Objectives:

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

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

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

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

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

UC25F03	Korean – I	L	T	P	C
		1	0	2	1

Course Objectives:

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

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

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

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

MA25C09	Computational Differential Equations	L	T	P	C
		3	1	0	4

Course Objectives: The Objectives of the course are to equip students with the ability to formulate and solve various types of Ordinary and Partial Differential Equations (ODEs & PDEs) and to develop proficiency in applying numerical methods and computational tools for solving differential equations encountered in engineering problems.

First Order Ordinary Differential Equations: Basic concepts of ordinary differential equations–Formation of first order differential equations from physical problems–First order and first-degree ODE: Variables separable–Exact equations–Leibnitz's equation – Bernoulli's equation – Numerical Methods: Solving first order ODE by Euler's formula, Taylor series and Runge Kutta method of 4th order.

Activities: Application and Visualization of the first order ODE using open-source software and solving Competitive Examination questions

Higher Order Ordinary Differential Equations: Formation of second order differential equations from physical problems–Linear equations of second and higher order with constant coefficients – Euler's linear equations – Method of variation of parameters–Numerical Methods: Solving second order ODE by Runge-Kutta method of 4th order and finite difference method.

Activities: solving ordinary differential equations using open-source software and solving of Competitive Examination questions

First Order Partial Differential Equations: Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions - Solution of PDE by variable separable method – Solution of standard types of first order partial differential equations (excluding reducible to standard types) – Lagrange's linear equation – Numerical Methods for first order PDE by Method of lines with Runge-Kutta method of order fourth.

Activities: Application and Visualization of the Partial Differential Equations using open-source software and solving Competitive Examination questions

Higher Order Partial Differential Equations: Linear homogeneous partial differential equations of second and higher order with constant coefficients. Numerical Methods: Finite difference techniques for the solution of two-dimensional Laplace's and Poisson's equations on rectangular domain—Solution of one-dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes—Solution of one-dimensional wave equation by explicit scheme.

Activities: Application of the second order PDE using open-source software of 1-D wave, 1-D heat equations, Laplace and Poisson equations 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 Examination questions (20%), Internal Examinations (40%).
References: 1. Erwin Kreyszig, Advanced Engineering Mathematics, (11th ed.), John Wiley & Sons, USA,2025. 2. Joe D. Hoffman, Numerical *Methods for Engineers and Scientists* (3rd ed.). CRC Press (Taylor & Francis Group), 2001. 3. Steven C. Chapra and Raymond P. Canale. *Numerical Methods for Engineers* (8th ed.). McGraw-Hill Education, 2021. 4. William E. Boyce and Richard C. DiPrima. *Elementary Differential Equations and Boundary Value Problems,* (11thed.). John Wiley & Sons, USA,2017. 5. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 45th Edition, 2026. 6. Randall J. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM,2007.
E-resources: 1. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/ 2. https://archive.nptel.ac.in/content/syllabus_pdf/111107063.pdf 3. https://github.com/patrickwalls/mathematicalpython

	Description of CO	**PO**	**PSO**
CO1	Explain first and higher-order ODEs using appropriate analytical and numerical techniques.	-	-
CO2	Solve higher-order PDEs using classical and finite difference methods.	PO1(3) PO5(3)	PSO1(2)
CO3	Apply various solution methods to differential equations arising in engineering contexts.	PO1 (3) PO5(3)	PSO2(1)
CO4	Interpretation of numerical solutions for partial differential equations and using open-source software.	PO2(3) PO5(3) PO11(2)	PSO2(1)

CH25201	Chemical Process Calculations	L	T	P	C
		3	1	0	4

Course Objectives:
To introduce the fundamental principles of material and energy balances in chemical processes, develop problem-solving skills using basic laws, property data, and flow diagrams, and to equip students with tools including psychrometric charts and process simulators for practical process analysis.

Measurement Systems and Units: Fundamental and derived units; unit conversions; dimensional consistency.

Basic Chemical Calculations: Density, viscosity & volume – relationship with temperature, concentration, flow rate, pressure, force, work, and power.
Chemical Properties: Molecular weight, atomic weight, empirical and molecular formulas, equivalent weight, average molecular weight. Physical Properties: Specific volume, specific gravity.

Activity: Evaluation of various properties of commonly used materials.

Ideal Gases and Gas Laws: Boyle's Law, Charles' Law, Dalton's Law, Amagat's Law.

Real Gases: Equations of state, Compressibility charts and their applications, Van der Waals equation, Real gas mixtures. Raoult's Law and Henry's Law. Vapour pressure and its significance. Concepts of absolute and relative humidity, dew point, humid volume, and humid heat, Use and interpretation of psychrometric charts.

Activity: Virtual Demonstration of Ideal and real gas behavior, and Determination of air properties from psychrometric charts.

Material Balances: Material balance calculations for single-unit systems With and Without chemical reactions, Material balances for multi-unit systems.

Activity: Material balances in distillation, crystallization, and absorption processes, followed by class discussion.

Energy Balances: Systems involving, Sensible heat, Latent heat and Chemical reactions (heat of combustion, heat of formation, and heat of reaction), Fuels and combustion.

Activity: Virtual Demonstration of Combustion process.

Combined Material and Energy Balances: Steady-state systems, Methodology, Introduction to Process Simulation Tools.

Activity: Usage of Simulation tools for material and energy balance.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%
Assessment Methodology: Quiz (10%), Assignments (20%), Review of GATE Questions (20%), Internal Examinations (50%)
References 1. Himmelblau, D. M., & Riggs, J. B. (2014). Basic principles and calculations in chemical engineering. Prentice Hall Inc. 2. Felder, R. M., & Rousseau, R. W. (2005). Elementary principles of chemical processes. John Wiley & Sons. 3. Narayanan, K. V., & Lakshmikutty, B. (2016). Stoichiometry and process calculations. Prentice Hall Inc. 4. Hougen, O. A., Watson, K. M., & Ragatz, R. A. (1973). Chemical process principles (Part I). CBS Publishers.
E-Resources 1. Simulation videos for activity: https://learncheme.com/simulations/mass-energy-balances/

	Description of CO	**PO**	**PSO**
CO1	Understand and explain the core concepts of process calculation in Chemical Engineering.	---	---
CO2	Apply and analyse the material and energy balance in chemical processes.	PO1 (3) PO2 (1)	PSO1(2)
CO3	Apply the appropriate gas equation and interpret data in engineering applications	PO1 (2) PO2 (2)	PSO1(1)
CO4	Demonstrate the ability to engage in adapting new techniques in the analysis of chemical process.	PO11 (1)	PSO3(3)

EL25C01	Chemical Engineering Thermodynamics	L	T	P	C
		3	1	0	4

Course Objective: To provide a comprehensive understanding of thermodynamic principles, including PVT behavior of fluids, laws of thermodynamics, property relations, and their applications to fluid flow, phase equilibria, and reaction equilibria.

First Law of Thermodynamics: Scope of thermodynamics, basic concepts and definitions, Equilibrium state and phase rule, Energy, Work, Temperature and Zeroth Law of Thermodynamics, reversible and irreversible process, First Law of Thermodynamics and its consequences. Application of first Law.

Activities: Analysis of thermodynamic systems, case studies based on the zeroth and First Law of Thermodynamics.

Second Law and Thermodynamic Correlations: Limitations of the first Law, statements of second Law of Thermodynamics, Thermodynamic Temperature scale, Entropy, Third law of thermodynamics.

Activities: Interpretation and Plotting graph**,** examine the limitations of the First Law of Thermodynamics and justify the necessity for the Second Law, evaluate entropy and its implications in natural processes.

PVT and Fundamental Properly Relations: Ideal gas- Equation of State involving ideal and real gas, Law of corresponding states, Compressibility chart, Thermodynamic Potentials, thermodynamic correlation, Maxwell relations. Clapeyron equation.

Activities: Analyze real gas behavior, assignment on thermodynamic relations.

Thermodynamics of Mixtures: Fugacity and Fugacity coefficient, Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, activity and property change of mixing, excess properties of mixtures. excess Gibbs free energy models.

Activities: Perform data-driven analysis of mixture behavior, apply the Gibbs–Duhem equation and excess Gibbs free energy models.

Phase Equilibria: Phase equilibrium in ideal solution, Raoultss law, Henry's law, Vapor Liquid Equilibrium at low, moderate and high pressures; bubble and dew point calculation, Phase diagrams for homogeneous systems, effect of temperature and pressure on azeotrope composition.

Activities: Perform vapor–liquid equilibrium calculations for ideal solutions, Analyze phase diagrams of homogeneous systems.

Reaction Equilibria: Chemical Reaction Equilibrium of single and multiple reactions, Standard Gibbs free change, equilibrium constant-effect of temperature; homogeneous gas and liquid phase reactions.

Activities: Analyze chemical reaction equilibria for single and multiple reactions, investigate the effect of temperature on equilibrium constant and composition, and solve equilibrium problems.

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

Assessment Methodology: Assignments (20%), Quiz (20%), Solving of Competitive Examinations Questions (10%), Internal Examinations (50%).

References:

1. Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, 7th Edition, Wiley India, New Delhi, 2009.
2. Narayanan, K.V. A Textbook of Chemical Engineering Thermodynamics Prentice Hall India, 2004
3. Smith, van Ness and Abbott, “Chemical Engineering Thermodynamics”, 7th Edition, McGraw Hill, New York, 2005
4. S. I. Sandler, Chemical, Biochemical and Engineering Thermodynamics, Wiley New York, 2006
5. Y V C Rao, “Chemical Engineering Thermodynamics”, Universities Press, Hyderabad 2005.
6. Pradeep Ahuja,” Chemical Engineering Thermodynamics”, PHI Learning Ltd (2009).
7. Gopinath Halder,” Introduction to Chemical Engineering Thermodynamics”, PHI Learning Ltd (2009)

E-Resources:

1. NPTEL Video Lectures – Thermodynamics and Chemical Industry https://ocw.mit.edu/courses/10-40-chemical-engineering-thermodynamics-fall-2003/?utm_source=chatgpt.com

CO Mapping with PO & PSO:

CO	Description of CO	PO	PSO
CO1	Apply thermodynamic principles to solve energy balance and property-related engineering problems.	PO1 (3) PO2 (2)	PSO1 (3)
CO2	Analyze the fundamental laws of thermodynamics and their applications to engineering systems.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Examine phase equilibrium, real gas behaviour, and mixture properties using appropriate thermodynamic models.	PO2 (3) PO4 (2)	PSO2 (2)
CO4	Assess system feasibility, equilibrium conditions, and performance under varying operating parameters.	PO3 (3) PO6 (1)	PSO1 (1)
CO5	Design and model thermodynamic systems by integrating thermodynamic laws, property relations, and equilibrium concepts.	PO3 (3) PO5 (2) PO11 (1)	PSO3 (2) PSO2 (1)

EL25302	Principles of Electrochemistry	L	T	P	C
		3	0	0	3

Course Objective:

To provide a comprehensive understanding of ion–solvent and ion–ion interactions, ion transport mechanisms in solutions, polarization and overpotential phenomena, colloidal electrochemistry, and electrochemical behaviour of modified electrodes along with their characterization.

Ion-Solvent & Ion-Ion Interactions: Ion-solvent interaction, ExperimentalΔH and ΔIon-solvent interaction – Expression for verification of Born Model, Ion-dipole model of ion-solvent interaction and expression for heat of solvation, Ion-Ion Interaction – True and Potential electrolytes, Debye-Huckel (ion-cloud) theory of ion-ion interactions, Activity coefficients and ion-ion interaction

Activities: Numerical problems on activity coefficients and Debye–Hückel theory; derivation-based exercises.

Ion Transport in Solution: Diffusion & Diffusion coefficient, Einstein-Smoluchowski equation, Conduction, Molar & Equivalent conductivity, Kohlrausch's Law, Ionic mobility, Stokes-Einstein relation, NernstEinstein equation, Transport numbers – determination by Hittorf's & Moving Boundary methods – Walden's rule - Debye Huckel-Onsager equation, non-aqueous solutions.

Activities: Problem-solving on conductivity and transport numbers; experimental data interpretation.

Polarisation And Over Potential: Electrolytic polarization, Dissolution and Decomposition potential, Overvoltage – hydrogen and oxygen overvoltage, applications, Polarography – principles, diffusion layer, limiting current density, polarographic circuit, dropping mercury electrode, merits & demerits, supporting electrolyte, current maxima, polarograms, half wave potential, diffusion current, applications.

Activities: Analysis of polarograms; numerical problems on overpotential and limiting current.

Colloidal Electrochemistry: Electrochemical properties of colloids – Charge on colloidal particles, Electrical Double Layer, Coagulation of colloidal sols, Electrokinetic phenomena - Electro-Osmosis – Determination of zeta potential, Electrophoresis – sedimentation potential (Dorn effect), Determination of colloidal particle size, Surfactant, Emulsion, Emulsifiers, gels – Applications.

Activities: Case studies on colloidal stability; calculations related to zeta potential.

Electroactive Layers and Modified Electrodes: Chemically modified electrodes, Types and methods of modification – chemisorption, covalent bond formation, polymer film coatings, inorganic materials, Langmuir-Blodgett (LB) methods, properties of the modified electrodes, electrochemistry at monolayer and multilayer modified electrodes, characterisation of modified electrodes.

Activities: Review of recent research papers; analysis of electrode modification techniques.

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

Assessment Methodology: Assignments (20%), Solution to application-oriented problems (20%), Research Paper presentation (20%), Internal Examinations (40%).

References:

1. J.O.M.Bockris & A.K.N.Reddy, "Modern Electrochemistry –Vol. I & II" , Plenum Press, New York, 2000.
2. Peter Atkins and Julio de Paula, "Physical Chemistry", VII Edition, Oxford University Press, New York, 2002
3. A.J. Bard and L.R. Faulkner, "Electrochemical Methods – Fundamentals and applications" 3 rd. edition John Wiley & Sons Inc, 2001.
4. Pallab Ghosh, "Colloid and Interface Science", PHI Ltd,2009.

E-Resources: NPTEL Lectures on Electrochemistry.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Apply electrochemical theories and models to explain ion–solvent and ion–ion interactions.	PO1 (3)	PSO1 (3)
CO2	Analyze ion transport mechanisms and conductivity behaviour in electrolyte solutions.	PO2 (3) PO4 (2)	PSO1 (2)
CO3	Evaluate polarization phenomena and overpotential effects in electrochemical processes.	PO2 (2) PO3 (3)	PSO2 (2)
CO4	Create models to predict electrochemical properties of colloids and electrokinetic phenomena.	PO4 (3) PO5 (2)	PSO1 (2) PSO2 (1)
CO5	Design modified electrodes and electrochemical systems using characterization techniques for targeted applications.	PO3 (3) PO5 (3) PO11 (2)	PSO2 (2) PSO3 (2)

EL25303	Fluid and Solid Operations	L	T	P	C
		3	1	0	4

Course Objective: To impart the students, the knowledge on fluid properties, fluid static and dynamic characteristics flow metering and transport, particle mechanics, techniques of solid – fluid separation

Properties of Fluid: Newtonian fluids Classification of fluid motion Fluid statics – equilibrium of fluid element – pressure variation in a static fluid – Differential analysis of fluid motion – continuity, Euler's and Bernoulli equation, Navier-Stokes Equation, Hagen-Poiseuilli flow.

Activities: Assignment on fluid statics, quiz on derivations.

Flow Through Pipes: Reynolds number regimes, boundary layer concepts; flow through pipes – pressure drop under laminar and turbulent flow conditions; ; Friction factor, Moody Chart, Flow meters; different types of flowmeters; Valves, pumps, compressors – characteristics and sizing; Agitation and Mixing;

Size Analysis: General characteristics of solids, techniques of size analysis; Laws of size reduction, equipment for size reduction

Activities: Solving numerical problems on flow through pipes.

Flow Through Fluidized Beds: Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds. Filtration – batch and continuous, filtration equipment - selection, operation.

Classifiers: Screening, gravity separation - sedimentation, thickening, elutriation, classifiers - Centrifugal separation - continuous centrifuges, cyclones and hydro cyclones, electrostatic and magnetic separators

Activities: A**n**alysis of filtration systems. Case studies on industrial separation techniques; numerical problems on sedimentation and centrifugation.

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

Assessment Methodology: Assignments (20%), Quiz/MCQ (20%), Solving numerical questions (10%), Internal Examinations (50%).

References:

1. Noel de Nevers, "Fluid Mechanics for Chemical Engineers", Second Edition, McGraw-Hill, (1991).
2. Badger W.L. and Banchero J.T., "Introduction to Chemical Engineering", Tata McGraw Hill, 1997.

3. Munson, B. R., Young, D.F., Okiishi, T.H. “Fundamentals of Fluid Mechanics”, 5th Edition “, John Wiley, 2006
4. McCabe W.L, Smith, J C and Harriot. P “Unit operations in Chemical Engineering”, McGraw Hill, V Edition, 2001
5. Coulson, J.M. and Richardson, J.F., "Chemical Engineering" Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.

E-Resources: NPTEL Lectures on Fluid Mechanics and Particle Technology

CO Mapping with PO and PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Apply the properties of fluids and governing equations of fluid motion to engineering systems.	PO1 (3)	PSO1 (3)
CO2	Analyze flow through pipes, flow measurement systems, and fluid transport equipment.	PO2 (3) PO4 (2)	PSO1 (3)
CO3	Evaluate particle characteristics, size reduction mechanisms, and size analysis techniques for process applications.	PO3 (3)	PSO2 (2)
CO4	Create models for predicting flow behaviour in fixed and fluidized beds and assessing filtration performance.	PO4 (3) PO5 (2)	PSO1 (2) PSO2 (1)
CO5	Design solid–fluid separation systems using sedimentation, centrifugation, and classification techniques for industrial applications.	PO3 (3) PO5 (3) PO11 (2)	PSO2 (2) PSO3 (2)

EL25304	Fluid and Solid Operations Laboratory	L	T	P	C
		0	0	4	2

Course Objective: To enable students to develop practical knowledge of crushing equipment and mechanical separation processes, and to experimentally analyze fluid flow systems including calibration of flow meters, pressure drop, and pump characteristics.

List of Experiments:

1. Sieve analysis
2. Batch filtration studies using a Leaf filter
3. Characteristics of batch Sedimentation
4. Reduction ratio in Jaw Crusher / Pulverizer/ Hammer Mill
5. Reduction ratio in Ball mill
6. Reduction ratio of Roll Crusher
7. Size separation using Sub-Sieving
8. Viscosity measurement of non-Newtonian fluids
9. Flow through annular pipe
10. Flow through helical coil and spiral coil
11. Pressure drop studies in packed column
12. Hydrodynamics of fluidized bed

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

Assessment Methodology: Lab report (30 %), Viva-Voce (20 %), Internal Assessment (50%)

References:

1. McCabe, W. L., Smith, J. C., & Harriott, P. Unit Operations of Chemical Engineering, 7th Edition, McGraw Hill Education, 2005.
2. Treybal, R. E. Mass Transfer Opera”lons’ 3rd Edition, McGraw Hill, 1980.

E-Resources:

NPTEL – Fluid Mechanics for Chemical Engineering

NPTEL Fluid Mechanics

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Apply the principles and experimental methods involved in fluid flow and solid handling operations during laboratory investigations.	PO1 (3)	PSO1 (3)
CO2	Analyze experimental data from fluid and solid operations to determine flow behaviour, particle dynamics, and process parameters.	PO2 (3) PO4 (3)	PSO1 (3)
CO3	Evaluate the performance of fluid and solid processing equipment with respect to efficiency, accuracy, and operational effectiveness.	PO4 (3) PO5 (3)	PSO2 (2)
CO4	Design and conduct experiments by applying fluid flow and solid operation principles to solve practical engineering problems.	PO3 (3) PO5 (3) PO11 (1)	PSO1 (2) PSO3 (2)

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

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

List of Activities

A. Elements of Effective Speaking and Listening

(i) Sharing life experience/ turning point in their life – SATORI

(ii) Situational Conversation – eg. Talking to a Senior about Internship Tips

(iii) Welcoming a Guest Speaker at a Seminar

(iv) Pictography to represent data using images or symbols

(v) B2-C1 Listening exercises include lectures, interviews, and discussions.

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication

(ii) Mini-Presentations: Topics like "My Dream Project," "Engineering in 2050," 3-minute technical pitches with logical flow

(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

(i) Introduction to Group Discussions - Key skills for effective participation

(ii) Phases in a GD and Conversational Phrases in GD.

(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries

(ii) Social Media Optimisation

(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

(i) Listening to podcast (motivational, career oriented, success stories)

(ii) Podcast Preparation – Purpose – Topic – Structure – Recording Tips - Publication of the Podcast

F. Mock Interviews and Communication Strategies:

(i) Listening – Job interview

(ii) Speaking – Mock interviews

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

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

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

References:

1. Floyd Kory, “Interpersonal Communication”, McGraw Hill Publication, 2023.
2. Bharadwaj Apoorva, “Leadership Communication Skills for Intercultural Management: Strategies for Effective Intercultural Management (Contemporary Themes in Business and Management)”, Routledge India; 1st edition, 2024.
3. Helen Spencer-Oatey and DomnaLazidou**, “**Making Working Relationships Work: The TRIPS Toolkit for Handling Relationship Challenges and Promoting Rapport”,Castledown Publishers,2023.
4. Presentations - Cambridge
5. Speaking Extra
6. Listening Extra – Miles Craven by Cambridge University Press
7. CVs, Resumes, and LinkedIn: A Guide to Professional English – Springer International Publishing

E-resources:

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

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

SEMESTER – IV

EL25402	Electrodics and Electrocatalysis	L	T	P	C
		3	0	0	3

Course Objectives: To provide a detailed understanding of electrical double layer concepts, electrode kinetics and electrocatalysis, and to familiarize students with advanced electrochemical techniques including potentiometry, amperometry, and impedance-based methods.

Electrical Double Layer: Thermodynamics of ideally polarizable and non-polarizable interfaces- Lipman equation determination of interfacial tension, charge density, surface excess and double layer capacitance by electro capillary & bridge methods- Helmholtz, Gouy-Chapman and stern models of the double layer with discussion of potential and charge distribution inside the double layer-contact adsorption and its determination.

Activities: N**u**merical problems on capacitance and charge distribution.

Electrode Kinetics: Concepts of equilibrium potential, Nernst equation, overpotential and its different types, equilibrium exchange current density-derivation of Butler-Volmer equation –high field and low field approximations – charge transfer resistance and polarizability of the interface – concepts of rate determining step, Stoichiometric number, reaction order – Determination of kinetics parameters [io, ks,$\beta(\alpha)$] by Tafel and linear polarization methods.

Activities: Numerical analysis of Tafel plots; derivation-based problems on Butler–Volmer equation.

Electrocatalysis: Chemical catalysis and electro catalysis – comparison of electrocatalysts – electro catalysis in simple redox reactions involving adsorbed species – electronic and geometric factors in electrocatalysts -Discussion on the mechanisms of hydrogen evolution and oxygen reduction reactions.

Activities: Case studies on electrocatalysts; mechanism analysis of HER and ORR.

Electrochemical Techniques I: Ion selective electrodes – Principles of potentiometry and amperometry- determination of dissolved oxygen. Linear sweep voltammetry and cyclic voltammetry derivation of Randles- Sevciks equation – effect of sweep rate-analysis of cyclic voltammograms.

Activities: Analysis of voltammograms; numerical problems on scan rate and peak current relationships.

Electrochemical Techniques II: Potential step method (chronoamperometry) under diffusion control derivation of Cottrell equation for a planar and spherical electrode- significance of spherical diffusion – derivation of Ilkovic equation.- Chronopotentiometry and analysis of chronopotentiograms-derivation of sands equation for constant current input under linear diffusion- concepts of Faradaic impedance –derivation of kinetic parameters from impedance measurements – Nyquist and bode plots for simple redox reactions-principles of scanning probe techniques-STM-AFM and SECM – working principles of electrochemistry. **Activities:** Interpretation of impedance plots; numerical problems on chronoamperometry and chronopotentiometry.
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.
Assessment Methodology: Assignments (20%), Application-oriented problem solving (20%), Research Paper presentations (20%), Internal Examinations (40%).
References: 1. J.O.M Bockris& A.K.N. Reddy, “Modern Electrochemistry”, Vol.2, Plenum Press, 1996. 2. A.J.Bard& L.R. Faulkner, ”Electrochemical Methods Fundamentals and Applications”, John Wiley & Sons. 3nd Edition, 2001.
E-Resources: 1. NPTEL Lectures on Electrochemistry and Electrocatalysis 2. Simulation tools for electrochemical techniques (CV, EIS, chrono methods)

CO Mapping with PO & PSO

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Apply engineering concepts to electrochemical systems, electrode kinetics, and principles of electrocatalysis.	PO1 (3)	PSO1 (3)
CO2	Analyze electrochemical reactions and electrode processes to understand kinetics, mechanisms, and transport phenomena.	PO2 (3) PO4 (2)	PSO1 (3)
CO3	Evaluate electrocatalytic systems and materials to assess their efficiency, performance, and applicability in energy and environmental processes.	PO3 (2) PO6 (1)	PSO2 (2)
CO4	Design electrochemical and electrocatalytic systems by applying principles of electrode kinetics and material selection for practical applications.	PO3 (3) PO5 (2) PO11 (1)	PSO1 (2) PSO3 (3)

EL25C02	Mass Transfer	L	T	P	C
		3	0	0	3

Course Objectives:

To impart knowledge on the mechanisms of mass transfer, understand various mass transfer operations, perform material balances in unit operations, solve engineering problems related to separation processes, and select appropriate design parameters for mass transfer equipment.

Molecular Diffusion: Introduction to mass transfer operations; Molecular diffusion in gases, liquids and solids; diffusivity measurement and prediction; multi-component diffusion.

Activities: Numerical problems on diffusion coefficients

Convective Transfer and Interphase Mass Transfer: Eddy diffusion, concept of mass transfer coefficients, theories of mass transfer, different transport analogies, application of correlations for mass transfer coefficients, inter phase mass transfer, relationship between individual and overall mass transfer coefficients.

Activities: Problem-solving on mass transfer coefficients; application of empirical correlations.

Absorption: Gas Absorption and Stripping – Equilibrium; material balance; limiting gas-liquid ratio; tray tower absorber - calculation of number of theoretical stages, tray efficiency, tower diameter; determination of height of packing using HTU and NTU calculations.

Activities: Stage-wise calculations; design problems on absorption columns.

Distillation: Vapour liquid equilibria - Raoult's law, Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc.Cabe - Thiele method, Total reflux, minimum reflux ratio, optimum reflux ratio.

Activities: Graphical construction of McCabe–Thiele diagrams; numerical problems on reflux ratio and stages.

Liquid: Liquid extraction - solvent characteristics-equilibrium stage wise contact calculations for single stage extraction, multi-stage cross current extraction, multi-stage counter current operation.

Solid liquid equilibria: Equilibrium diagram for leaching, single stage leaching, multi stage continuous cross current and counter current leaching, stage calculations, stage efficiency.

Activities: Ternary diagram analysis; numerical problems on extraction and leaching operations.
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.
Assessment Methodology: Assignments (20%), Application-oriented problem solving (20%), Solving competitive exam -type questions (20%), Internal Examinations (40%).
References: 1. Treybal, R.E., "Mass Transfer Operations ", 3rd Edn., McGraw-Hill, 1981.ISBN-10: 1259029158 2. Geankoplis, C.J., "Transport Processes and Unit Operations", 4th Edition, Prentice Hall Inc., New Jersey, 2003. ISBN-10 : 1292026022 3. Richardson J.F., and Harker J.H., "Coulson and Richardson's, Chemical Engineering – Volume 2", Butterworth-Heinemann, 2002 ISBN: 0750644451. 4. McCabe, W.L., Smith, J.C., and Harriot, P., "Unit Operations in Chemical Engineering", 7th Edition, McGraw-Hill, 2005. 5. Seader J.D. and Henley E.J., "Separation Process Principles", 2nd Ed., John Wiley, 2006. 6. Wankat, P., "Equilibrium Stage Separations", Prentice Hall, 1993. 7. Binay K. Dutta, "Principles of Mass Transfer and Separation Processes", PHI Learning Ltd, 2009.
E-Resources: 1. https://archive.nptel.ac.in/courses/103/103/103103154/ 2. https://archive.nptel.ac.in/courses/103/103/103103035/ 3. https://www.nptelvideos.com/course.php?id=169

CO Mapping with PO & PSO

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Apply molecular diffusion concepts and mass transfer mechanisms in gases, liquids, and solids.	PO1 (3)	PSO1 (3)
CO2	Analyze convective and interphase mass transfer processes using transport correlations and mass transfer coefficients.	PO2 (3) PO4 (2)	PSO1 (3)
CO3	Evaluate gas absorption and stripping operations using stage-wise and HTU–NTU methods.	PO3 (2) PO4 (2) PO6 (1)	PSO2 (2)
CO4	Design distillation systems and determine stage requirements using equilibrium concepts and the McCabe–Thiele method.	PO3 (3) PO5 (2) PO8 (1)	PSO1 (3)

CO5	Create separation and purification schemes using liquid–liquid extraction and leaching principles for industrial applications.	PO3 (3) PO6 (1) PO7 (1) PO9 (1) PO11 (1)	PSO2 (2) PSO3 (2)

EL25403	Chemical Reaction Engineering	L	T	P	C
		3	1	0	4

Course Objectives:

To enable students to understand the kinetics of homogeneous reactions, analyze reactor configurations, study different types of chemical reactors, and design reactors under isothermal and non-isothermal conditions for industrial applications.

Rate equation, elementary, non-elementary reactions, theories of reaction rate and Prediction; Design equation for constant and variable volume batch reactors, analysis of experimental kinetics data, integral and differential analysis.

Activities: A**n**alysis of experimental kinetic data.

Design of continuous reactors - stirred tank and tubular flow reactor, recycle reactors, Equal sized CSTRs in series and parallel, Equal sized PFRs in series and parallel, size comparison of reactors.

Activities: Design calculations for CSTR and PFR; comparison of reactor configurations.

Design of reactors for multiple reactions - consecutive, parallel and mixed reactions - factors affecting choice, optimum yield and conversion, selectivity, reactivity and yield.

Activities: case studies on reactor selection and design.

Non-isothermal homogeneous reactor systems, adiabatic reactors, rates of heat exchanges for different reactors, design for constant rate input and constant heat transfer coefficient, operation of batch and continuous reactors, optimum temperature progression.

Activities: Analysis of temperature effects on reaction rates.

The residence time distribution as a factor of performance; residence time functions and relationship between them in reactor; basic models for non-ideal flow; conversion in non-ideal reactors.

Activities: RTD curve analysis

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

Assessment Methodology: Assignments (20%), Quiz/MCQ (20%), Solving competitive -type questions (10%), Internal Examinations (50%).

References:

1. Levenspiel O, “Chemical Reaction Engineering”, Wiley Eastern Ltd., II Edition, 2000.
2. Smith, J.M, “Chemical Engineering Kinetics”, McGraw Hill, III Edition, 1981.

3. Fogler.H.S., “Elements of Chemical Reaction Engineering”, Prentice Hall of India Ltd., 3rd Edition, 2000.
4. Froment. G.F. & K.B.Bischoff, “Chemical Reactor Analysis and Design”, John Wiley and Sons, 1979.

E-Resources:

1. NPTEL Lectures on Chemical Reaction Engineering
2. Simulation tools for reactor design and kinetics analysis

CO Mapping with PO and PSO

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Apply the concepts of reaction kinetics, rate laws, and chemical reactor principles in engineering applications.	PO1 (3)	PSO1 (3)
CO2	Analyze reaction kinetics and reactor performance to determine conversion, reaction rate, and process efficiency.	PO2 (3) PO4 (2)	PSO1 (3)
CO3	Evaluate reactor models and operating conditions to assess their effectiveness and suitability for specific reactions.	PO3 (2) PO6 (1)	PSO2 (2)
CO4	Design chemical reactors by applying reaction engineering principles to develop efficient, safe, and optimized process systems.	PO3 (3) PO5 (2) PO7 (1) PO8 (1) PO9 (1) PO11 (1)	PSO1 (3) PSO3 (2)

CH25C06	Heat Transfer	L	T	P	C
		3	0	2	4

Course Objectives: To provide knowledge on conduction, convection, radiation, phase change heat transfer and heat exchanger design for chemical engineering applications.

Conduction: Introduction to heat transfer-General heat conduction equation, One dimensional steady state conduction in rectangular coordinate, One dimensional steady state conduction in cylindrical and spherical coordinate; Critical and optimum insulation; Extended surface heat transfer; Transient heat flow - Analysis of lumped parameter model – applications.

Practicals:

1. Measurement of thermal conductivity
2. Heat transfer studies through composite wall
3. Heat transfer in Bare and Finned Tube Heat Exchanger

Activities: Analyze steady and transient heat conduction problems in different geometries.

Convection: Introduction to Convective Heat Transfer; Dimensional analysis for -forced convection, free convection; Heat transfer co-relations for - laminar and internal flows, turbulent and internal flows, Co-relation for turbulent and external flows, for flow across tube banks, Momentum.Heat transfer analogies; Boundary layer heat transfer- Equations, Approximate analysis in boundary layer, Theoretical concepts of natural / free convention heat transfer; Empirical relations for free convention heat transfer.

Practicals:

1. Heat transfer studies by forced convection

Activities:

Analyze convective heat transfer mechanisms under forced and natural convection, apply dimensional analysis and empirical correlations.

Heat Exchanger: Classification of heat exchangers; Co-current, Counter current& Cross-current; log-mean temperature difference; overall heat transfer coefficient; fouling factors. Various types of shell and tube heat exchangers; Effectiveness-NTU; method of heat exchanger analysis; Design of - double pipe heat exchanger, shell and tube heat exchanger & Plate and Spiral Heat exchangers.

Practicals:

1. Heat transfer Studies in Shell and Tube heat exchanger
2. Heat transfer in Double pipe heat exchanger

Activities: Perform preliminary design calculations for industrial heat exchangers.

Heat Transfer with Phase Change: Boiling and Condensation-Types-Condensation heat transfer over vertical plate, Condensation heat transfer for various conditions & geometries, Fundamentals of boiling heat transfer, boiling heat transfer co-relations.

Evaporation: Types of evaporators, boiling point elevation and Duhring's rule, material and energy balances for single and multiple effect evaporators: forward, mixed and backward feeds, capacity and economy of evaporators.

Practicals:
1. Heat transfer in Horizontal and vertical condenser
2. Heat transfer in Helical coil

Activities: Analyze boiling and condensation heat transfer mechanisms, evaluate evaporator performance and economy, solve material and energy balance problems in multiple effect evaporators.

Radiation & Industrial Applications: Introduction to radiation heat transfer, Thermal Radiation laws, Black and Gray bodies, Properties of a Blackbody, Kirchhoff's Law, Radiation intensity and radiation view factor, Radiation heat exchange, Radiation shield and gas radiation, emissivity, radiation between black surfaces and grey surfaces. Solar radiations, combined heat transfer coefficients by convection and radiation. Industrial applications -Heat transfer through packed and fluidized bed.

Practicals:
1. Emissivity measurement
2. Heat transfer in packed column

Activities:
Analyze radiative heat transfer between surfaces.

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

Assessment Methodology: Assignments (20%), Experimental data analysis and heat transfer calculations (20%), Quiz/MCQs (20%), Internal Examinations (40%).

References:

1. Incropera, F. P. & Dewitt, D. P., (2011), Fundamental of Heat and Mass Transfer, John Wiley & Sons ISBN-10: 0-471-45728-0
2. Holman, J. P., 'Heat Transfer ', 8th Edn., McGraw Hill, 1997. **ISBN-10 :** 0078447852
3. Ozisik, M. N., Heat Transfer: A Basic Approach, McGraw-Hill, 1984 **ISBN-10 :** 0070479828
4. Kern, D.Q., "Process Heat Transfer ", McGraw-Hill, 1999. **ISBN-10 :** 0070341907

5. Cengel, Y.A. (2002) Heat Transfer: A Practical Approach. 2nd Edition, McGraw-Hill, New York.
6. Coulson, J.M. and Richardson, J.F., “Chemical Engineering “Vol. I, 4th Edn., Asian Books Pvt. Ltd., India, 1998.
7. McCabe, Warren L., Julian C. Smith, and Peter Harriott. Unit Operations of Chemical Engineering. 5th ed. New York; London: McGraw-Hill, 1993.

E-Resources:

1. NPTEL courses on Heat Transfer and Process Heat Transfer.
2. SWAYAM online modules on conduction, convection and radiation heat transfer.
3. Virtual laboratory simulations for heat exchangers and phase change heat transfer.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Apply conduction heat transfer principles in different geometries under steady and transient conditions.	PO1 (3)	PSO1 (2)
CO2	Analyze convective heat transfer processes and determine heat transfer coefficients for internal and external flows.	PO2 (3) PO5 (2)	PSO1(2) PSO2 (1)
CO3	Design heat exchangers using LMTD and effectiveness–NTU methods for industrial applications.	PO3 (3) PO4 (2)	PSO1(2) PSO2 (1)
CO4	Evaluate boiling, condensation, and evaporation processes employed in industrial heat transfer operations.	PO3 (3) PO6 (1)	PSO2 (2)
CO5	Create efficient thermal systems involving radiation, packed beds, and fluidized beds for industrial applications.	PO5 (3) PO6 (2) PO7 (1) PO9(1) PO11 (1)	PSO2(2) PSO3 (1)

EL25404	Instrumental Methods of Analysis	L	T	P	C
		3	0	0	3

Course Objectives:

To enable students to understand the fundamentals and mechanisms of spectral analysis, qualitative and quantitative spectroscopic techniques, IR spectroscopy, and chromatographic methods used in chemical analysis.

Introduction To Spectroscopical Methods of Analysis: Electromagnetic radiation: various ranges, dual properties, various energy levels, interaction of photons with matter, absorbance & transmittance and their relationship, permitted energy levels for the electrons of an atom and simple molecules, various electronic transitions in organic and inorganic compounds effected by UV, and visible radiations, various energy level diagrams of saturated, unsaturated and carbonyl compounds, excitation by UV and visible radiations, choice of solvents, cut off wavelengths for solvents.

Activities: Numerical problems on absorbance and transmittance; interpretation of energy level diagrams.

Qualitative Analysis by UV And Visible Spectrocopy: Lamda max and epsilon max rules, Woodward -Fieser rules for the calculation of absorption maxima (Lamda max) for dienes and carbonyl compounds, Effects of auxochromes and effects of conjugation on the absorption maxima, Different shifts of absorption peaks (Bathochromic, hypsochromic, hypochromic), Instrumentation for UV and Visible spectrophotometers (source, optical parts and detectors), Applications of UV and Visible spectroscopy.

Activities: Prediction of λmax using Woodward–Fieser rules; interpretation of UV spectra.

Quantitative analysis By UV And Visible Spectrocopy: Beer-Lambert's law, limitations, deviations (real, chemical, instrumental), estimation of inorganic ions such as Fe, Ni and estimation of nitrite using Beer -Lambert's law, multicomponent analysis (no overlap, single way overlap and two-way overlap), photometric titration (experimental set -up and various types of titrations and their corresponding curves).

Activities: Numerical problems based on Beer–Lambert law; analysis of photometric titration curves.

IR Spectroscopy: Theory of IR spectroscopy, various stretching and vibration modes for diatomic and triatomic molecules (both linear and nonlinear), various ranges of IR (near, mid, finger print and far) and their usefulness, Instrumentation

(only the sources and detectors used in different regions), sample preparation techniques, qualitative analysis of alkanes, alkenes and carbonyl compounds.

Activities: Interpretation of IR spectra; identification of functional groups.

Chromatographic Methods: Classification of chromatographic methods, column, thin layer, paper, gas, High Performance Liquid Chromatographical methods (principle, mode of separation and technique).

Activities: Separation case studies; analysis of chromatograms and retention times.

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

Assessment Methodology: Assignments (20%), Application-oriented problem solving (20%), Research Paper presentation (10%), Internal Examinations (50%).

References:

1. Sivasankar B., “Instrumental Methods of Analysis”, Oxford University Press, 2012.
2. William Kemp, Organic Spectroscopy, 3rd Edition, Palgrave publishers, 2007
3. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Instrumental Analysis, CENGAGE Learning, India, 7th Edition, 2007.
4. Willard H.H, Merritt L.L, Dean J.A and Settle F.A, Instrumental method of analysis, 7th edition, Wadsworth Publishing Company, 1988.
5. Gurdeep R. Chatwal, Sharma K. Anand, Instrumental methods of Chemical Analysis, Himalaya Publishers, New Delhi, 2014
6. John R Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice-hall of India Pvt. Ltd., 2012
7. Robert M. Silverstein, Francis X. Webstrer, David Kiemle, David L. Bryce, Spectrometric Identification of Organic Compounds, Wiley, 8th Edition, 2010.

E-Resources:

1. Interpretative Molecular Spectroscopy (SWAYAM-NPTEL, IIT Bombay)
2. Modern Instrumental Methods of Analysis (NPTEL)
3. Analytical Chemistry (NPTEL, IIT Kharagpur)

CO Mapping with PO and PSO

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles, instrumentation, and applications of spectroscopic, chromatographic, and electroanalytical techniques used in chemical analysis.	-	-
CO2	Apply spectroscopic, chromatographic, and electroanalytical methods for qualitative and quantitative chemical analysis.	PO1 (3) PO5 (2)	PSO1 (3)
CO3	Analyze analytical data obtained from UV-Visible, IR, chromatographic, and electrochemical techniques for chemical characterization.	PO2 (3) PO4 (2)	PSO1 (2) PSO2 (2)
CO4	Evaluate the performance and suitability of analytical instruments and methodologies in terms of accuracy, precision, sensitivity, and reliability for industrial applications.	PO3 (2) PO5 (2) PO11 (1)	PSO2 (2) PSO3 (2)

CH25C07	Introduction to Standards in Chemical Engineering	L	T	P	C
		1	0	0	1

Course Objectives:
To familiarize students with the basic codes, symbols, and standards used in process industries, and to equip them with the knowledge and skills required for the selection and sizing of process equipment, valves, and control systems.

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

Activities: Case studies on industrial standards; review of BIS and ISO specifications.

Symbols: Recommendation for letter symbols, signs and abbreviations used in chemical engineering, Color code for identification of pipelines, Recommendations on Graphical Symbols for Process Flow Diagrams, Piping and Instrumentation Diagrams, Graphical symbols for pipelines and instrumentation diagrams

Activities: Interpretation of PFDs and P&IDs; drawing standard symbols for process systems.

Process Equipment: Recommendation on nominal capacities for process equipment, Recommendation on nominal diameter for process equipment, Crushing and grinding equipment - Classification and methods for measuring capacity, Sizes of process vessels and leading dimensions, Shell and Tube Type Heat Exchangers, Shell Flanges for Vessels and Equipment, Data sheet for shell and tube type heat exchangers.

Activities: Equipment sizing calculations; analysis of industrial datasheets.

Valves And Controls: Nominal sizes for valves, Marking system for valves, Dimensions for ferrous valves - face to face and end to end, General Purpose Ball Valves, Cast or Forged Steel Check Valves (Flanged or Butt Welding Ends) for Petroleum, Petrochemicals, Chemicals and Allied Industries, Fire test for valves (including soft seated quarter turn valves) - Method of test.
Process measurement control functions and instrumentation - Symbolic representation, Part 1 to 4

Activities: Selection of valves for process applications; interpretation of control loop diagrams.
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.
Assessment Methodology: Assignments (20%), Application-oriented problem solving (20%), BIS Standards presentation (10%), Internal Examinations (50%).
References 1. Bureau of Indian Standards, IS 3030:1965, IS 2379:1990, IS 3232:1999, and IS 9446:1980, New Delhi, India. 2. Bureau of Indian Standards, IS 2843:1964, IS 2844:1964, IS 3612:1994, IS 4179:1967, IS 4503:1967, IS 4864–4870:1968, and IS 10123:1982, New Delhi, India. 3. Bureau of Indian Standards, IS 9520:2008, IS 9866:1981, IS 9884:1981, IS 9890:1981, IS 10989:1984, IS 11611:1992, and IS 12754 (Parts 1–4):1989 (ISO 3511 Parts 1–4), New Delhi, India.
E-Resources: 1. BIS official website and standards database 2. ISO standards repository 3. NPTEL lectures on process design and instrumentation

CO Mapping with PO and PSO

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the fundamental concepts of engineering standards, codes, safety regulations, and quality systems used in chemical engineering industries.	-	-
CO2	Apply national and international standards in chemical process design, safety management, and quality assurance practices.	PO2 (3) PO5 (1)	PSO1 (3)
CO3	Analyze the role of standards and regulatory frameworks in ensuring safety, reliability, and environmental compliance in chemical industries.	PO6 (3) PO7 (2)	PSO2 (2)
CO4	Design chemical processes and systems by incorporating relevant engineering standards, codes, and safety guidelines for industrial applications.	PO3 (3) PO5 (2) PO8 (1) PO9 (1) PO11 (1)	PSO1 (2) PSO3 (3)

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

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

List of Activities

Stage Ready – Impactful Public Speaking .

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

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

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

Professional and Application-Oriented Writing

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

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

Receptive Skills in Workplace Communication·

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

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

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

Intercultural Communication

(i) Assertive vs Aggressive communication

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

From Campus to Career: Industry Skills and Global Exam Preparation

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

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

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

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

End Semester Assessment:

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

References:

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

E-resources:

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

CO Mapping with PO & PSO

	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)

EL25404	Electrochemistry Laboratory	L	T	P	C
		0	0	4	2

Course Objectives: To enable the students to develop a sound working knowledge on different types of electrochemical techniques and electrochemical parameter calculations.

List of experiments:

1. Fabrication of Reference electrode (Ag/AgCl) and its validation
2. Fabrication of modified electrodes and calculation of surface excess
3. Potentiometric titration of redox couple (Fe/Ce ions)
4. Estimation of equilibrium potential of quinhydrone electrode (pH dependence)
5. Determination of formal potential and diffusion coefficient for a reversible process using ferricyanide and ferrocyanide
6. Distinguish between inner and outer sphere processes using Pt and glassy carbon electrode
7. Effect of dissolved oxygen in electrochemical reduction of nitrophenol
8. Amperometric method for sensing hydrogen peroxide
9. Determination of dihydroxy phenols using cyclic voltammetry
10. Investigation of electrochromism using electropolymerisation on a ITO substrate
11. Double-layer capacitance measurement using cyclic voltammetry
12. Electrode surface area measurement using a redox probe.

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

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

References:

1. Bard, A. J., & Faulkner, L. R. Electrochemical Methods: Fundamentals and Applications, 2nd Edition, John Wiley & Sons, 2001.

CO Mapping with PO and PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the fundamental principles, instrumentation, and experimental procedures involved in electrochemical systems and measurements.	PO1 (3)	PSO1(3)
CO2	Apply electrochemical techniques to determine conductivity, electrode potential, and reaction kinetics through laboratory experiments.	PO1(3) PO5 (2)	PSO1(3)
CO3	Analyze experimental data and evaluate the performance of electrochemical systems with respect to accuracy, efficiency, and reliability.	PO2(3) PO4 (3)	PSO2 (2)
CO4	Design and conduct electrochemical experiments to solve practical engineering and scientific problems using appropriate methodologies and instruments.	PO3(3) PO5(2) PO8(1) PO9(1) PO11(1)	PSO1(2) PSO3 (3)