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ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B.Tech. Chemical 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, efficient chemical processes for industrial applications.

PSO 2: Use modern tools and adapt sustainable practices to address the complex problems in chemical engineering.

PSO 3: Upskill with rapid advancements in the field of Chemical Engineering and exhibit research aptitude, work effectively as team and uphold ethical 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	2-0-0	2	2	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	**32**	**22**	

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.	CY25C04	Applied Chemistry (Tech) - II	T	2-0-0	2	2	BS
3.	EE25C01	Basic Electrical and Electronics Engineering	T	3-0-0	3	3	ES (G)
4.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	T	1-0-0	1	1	HUM
5.	CH25201	Chemical Process Calculations	T	3-1-0	4	4	ES (PC)
6.	PH25C06	Applied Physics (Tech) – II	T	2-1-0	3	3	BS
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		**40**	**28**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	Course Code	Course Name	Course Type	Periods / Week		Credits	Category
				L-T- P	TCP		
1.	MA25C03	Computational Differential Equations	T	3-1-0	4	4	BS
2.	CH25301	Chemical Engineering Thermodynamics I	T	3-0-0	3	3	ES (PC)
3.	CH25302	Chemical Technology	T	3-0-0	3	3	ES (PC)
4.	CH25303	Material Technology	T	3-0-0	3	3	ES (PC)
5.	CH25C02	Mechanical Operations	LIT	3-0-2	5	4	ES (PC)
6.	CH25C03	Fluid Mechanics	LIT	3-0-2	5	4	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.	CH25C04	Chemical Reaction Engineering I	LIT	3-0-2	5	4	ES (PC)
2.	CH25401	Chemical Engineering Thermodynamics II	T	3-0-0	3	3	ES (PC)
3.	CH25C05	Mass Transfer I	LIT	3-0-2	5	4	ES (PC)
4.	CH25C06	Heat Transfer	LIT	3-0-2	5	4	ES (PC)
5.	CH25C07	Introduction to Standards in Chemical Engineering	T	1-0-0	1	1	ES (PC)
6.	CH25C08	Process Dynamics and Control	LIT	3-0-2	5	4	ES (PC)
7.	---	Skill Development Course – I	LIT	1-0-2	3	2	SD
8.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
			Total Credits		**29**	**23**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Chemical Reaction Engineering II	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.		Programme Elective III	T	3-0-0	3	3	ES (PE)
5.		Mass Transfer II	LIT	3-0-2	5	4	ES (PC)
6.		Industry Oriented Course - I	LIT	1-0-2	3	1	SD
7.		Skill Development Course – II	LIT	1-0-2	3	2	SD
8.		Chemical Reaction Engineering and Process Control Lab	L	0-0-4	4	2	ES (PC)
			Total Credits		**27**	**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.		Transport Phenomena	T	3-0-0	3	3	ES (PC)
2.		Process Equipment Design	LIT	3-0-2	5	4	ES (PC)
3.		Programme Elective IV	T	3-0-0	3	3	ES (PE)
4.		Open Elective	T	3-0-0	3	3	ES (OE)
5.		Data Science for Chemical Engineers	T	3-0-0	3	3	ES (PC)
6.		Industry Oriented Course II	LIT	1-0-2	3	2	SD
7.		Skill Development Course – III	LIT	1-0-2	3	2	SD
8.		Self-Learning Course	---	---	0	1	SL
			Total Credits		**23**	**21**	
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	LIT	2-0-2	4	3	HUM
2		Safety & Risk Analysis in Process Industries	T	3-0-0	3	3	ES (PC)
3		Climate Change and Sustainability	T	2-0-0	2	2	HUM
4		Process Plant Utilities	T	3-0-0	3	3	ES (PE)
5		Programme Elective V	T	3-0-0	3	3	PE
6		Project Management	T	2-0-0	2	2	SD
7		Internship / Industry Project	L	0-0-2	2	1	SD
Total Credits					**19**	**17**	
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: 162

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 & Wastewater 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 Flowsheeting	Power Plant Engineering	Process Safety Management	Electrometallurgy and Thermics	Nanomaterials & 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) (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.

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

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

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

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

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

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

References:

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

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* (17th ed.). 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* (4th ed.). McGraw Hill Publishers.
3. Guttag, J. V. (2016). *Introduction to computation and programming using Python: With applications to understanding data* (2nd ed.). 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)

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	PSO
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)

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	PSO1
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)

UC25H02	தமிழர்களும் தொழில்நுட்பமும்	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.

UC25H02	Tamils and Technology	L	T	P	C
		1	0	0	1

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

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

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

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

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

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

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

References

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – 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.

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. To develop problem-solving skills using basic laws, property data, and flow diagrams.
- 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

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)

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)

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. **CAD 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 (2nd ed.). Tuttle Publishing.
2. Cho, Y., Lee, H., Schulz, C., Sohn, H.-M., & Sohn, S.-O. (2001). Integrated Korean: Beginning 1. University of Hawai‘i Press.

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

SEMESTER III

MA25C03	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)

CH25301	Chemical Engineering Thermodynamics I	L	T	P	C
		3	0	0	3

Course Objectives:
To provide a comprehensive understanding of thermodynamic laws, PVT behavior, property relations and their applications in analyzing energy transfer, fluid flow and thermodynamic processes in chemical engineering systems.

Thermodynamic Fundamentals: Terminologies of thermodynamics, the variables and quantities of thermodynamics, characteristics of systems and processes, energy classifications, point and path functions, energy in transition work and heat. Zeroth law; temperature scales.

Activities: Solving numerical problems on zeroth law

First Law & PVT Behavior: The first law of thermodynamics, statements of first law for the flow and non-flow processes. PVT behaviour of fluids; Mathematical representation of PVT behaviour; generalized compressibility factor correlation; generalized equations of state.

Activities: Solving numerical problems on first law and graphical representation of PVT behaviour

Second Law & Entropy: Joule's experiment, energy balance for closed systems, mass and energy balance for open systems, Statements of the second law of thermodynamics, heat engine and refrigerator, Carnot cycle and Carnot theorems, thermodynamic temperature scale, entropy and its calculation, second law of thermodynamics for a control volume, Third law of thermodynamics, entropy from a microscopic point of view.

Activities: Problem solving on second law and entropy

Property Relations: Thermodynamic properties – internal energy, enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations – Maxwell relations – partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams.

Activities: Relating thermodynamic properties

Thermodynamic Applications: Thermodynamic aspects of compression, expansion processes and duct flow of compressible fluids, steam power plant.

Activities: Practical / Industrial case studies

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

Assessment Methodology: Assignments (20%), Quiz / MCQs (20%), Solving of Competitive type exam questions (20%), Internal Examinations (40%).

References

1. Smith J.M., VanNess,H.C., &Abbot M.C," Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2009
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics"Prentice Hall of India Pvt.Ltd,2 nd edition,2013..
3. Rao Y.V.C.,"Chemical Engineering Thermodynamics"Universities Press, 2005
4. Sandler,S.I.,"Chemical and Engineering Thermodynamics",IV edition,Wiley,2006.
5. Koretsky.,Engineering and Chemical thermodynamics,Wiley,2011
6. Kyle B.G.,"Chemical and Process Thermodynamics", Pearson International third Edition.
7. Kevin Douglas, Fundamentals of Chemical Engineering Thermodynamics, Timothy Anderson,2015.

E-Resources:

1. SWAYAM / NPTEL courses on Thermodynamics

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand thermodynamic principles, properties, and laws governing energy interactions in engineering systems.	–	–
CO2	Apply the First and Second Laws of Thermodynamics to analyze energy and mass balances in flow and non-flow processes.	PO1 (3) PO2 (2)	PSO1 (3)
CO3	Analyze PVT behavior of fluids, compressible flow, and thermodynamic cycles using equations of state and property relations.	PO2 (3) PO5 (2)	PSO1 (2) PSO2 (2)
CO4	Evaluate the performance and efficiency of thermodynamic systems such as compressors, turbines, and steam power plants.	PO3 (3) PO4 (2) PO6 (1)	PSO1 (2) PSO2 (2)
CO5	Design thermodynamic processes and cycles for efficient and sustainable chemical engineering applications.	PO3 (3) PO5 (2) PO7 (1) PO9 (1) PO11 (1)	PSO2 (2) PSO3 (2)

CH25302	Chemical Technology	L	T	P	C
		3	0	0	3

Course Objectives:

To impart knowledge on unit operations, unit processes, manufacturing flow sheets, process engineering aspects, and industrial applications involved in major chemical process industries.

Sugar And Wood Based Industries: Introduction to chemical processing; symbolic representation of different unit operations and unit processes to build a flow sheet; Production of pulp and paper, Manufacture of sugar, starch and starch derivatives.

Activities: Prepare process flow diagrams for pulp, paper and sugar industries, studies about by-product formation in starch and sugar manufacturing industries. Description of latest technology for starch and sugar manufacturing industries.

Alkalis and Acids Industries Chlor - alkali Industries: Manufacture of Soda ash, Manufacture of caustic soda and chlorine - common salt. Sulphur and Sulphuric acid: Mining of sulphur and manufacture of sulphuric acid, Manufacture of hydrochloric acid.

Activities: Evaluate process flow sheets and identify engineering challenges in alkali and acid manufacturing plants. Description of latest technology alkali and acid manufacturing plants.

Cement, Oil, Paint and Petrochemical Industries Cement-Types and Manufacture of Portland cement, Refining of edible oils and fats, fatty acids, Manufacture of Soaps and detergents; Manufacture of paints and Varnishes–Pigments, Petroleum refining-physical and chemical conversion products, lubricating oil, petrochemical precursors, chemicals from aromatics.

Activities: Description of latest technology for the above industries. Analysis of pollution emission in cement, paint, and petroleum industries.

Fibers, Silica and Industrial Gases - Natural and synthetic fibers- Manufacture of nylon 6,6 and nylon 6 fibers, viscose rayon and polyester fibers; PET, Nature, types, composition and uses of glass-its manufacture, melting, shaping, annealing and finishing operations; ceramics and refractories: Fuel gases-producer gas, coke oven gas, natural gas, LNG Industrial gases-carbon dioxide, hydrogen, nitrogen and oxygen.

Activities: Compare properties and applications of glass, ceramics and refractories, construct P&ID for fuel gas and industrial gas production processes.

Fertilizer Industries Nitrogen Fertilizers; Synthetic ammonia, nitric acid, Urea, Phosphorous Fertilizers: Phosphate rock, phosphoric acid, super phosphate and Triple Super phosphate, ammonium phosphate, potassium chloride, potassium phosphate.

Activities: Evaluate raw material utilization and by-product generation in fertilizer industries, analyze major engineering problems associated with ammonia, urea and phosphate fertilizer production. Analysis of pollution emission for the manufacturing processes.

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

Assessment Methodology: Assignments (20%), Process flow sheet drawing and analysis (20%), Quiz/MCQs(20%), Internal Examinations (40%).

References:

1. Dryden, C. E., “Outlines of Chemicals Technology”, Edited and Revised by Gopala Rao, M.and M. Sittig, Second Edition, Affiliated East-West press, 1993, ISBN NO: 9788185938790
2. Austin, G. T., “Shreve’s Chemical Process Industries”, Fifth Edition, McGraw Hill, Singapore, 1984, ISBN NO: 9781259029455:
3. PATEL H.J. "Handbook For Chemical Process Industries" , TAYLOR & FRANCIS, CRC Press,2024, ISBN NO: 10-1032534826
4. B.K.Baskararao, “Text book on Petrochemicals” 5th edition, Khanna Publishers,2004
5. Robert O. Ebewele, “Polymer Science and Technology” 1st Edition, CRC Press,2000
6. Brahma Mishra, “Fertilizer Technology and Management” Published by I.K. International Publishing House, 2012.
7. Smith W, "Chemical Process Industries, Volume 1: Organic Chemicals and Allied Industries", CBS Publishers & Distributors Pvt Ltd, India, 2017
8. Smith W and Chapman R, "Chemical Process Industries, Volume 2: Inorganic Chemicals and Allied Industries", CBS Publishers & Distributors Pvt Ltd, India, 2018

E-Resources:

1. NPTEL Courses on Chemical Technology and Process Industries.
2. AICTE e-learning resources and SWAYAM platform.
3. Industrial process videos and virtual plant simulations from reputed chemical industries.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand the unit operations, unit processes, symbols, and flow schemes involved in pulp, paper, sugar, starch, and derivative industries.	–	–
CO2	Apply principles of chemical technology to manufacturing processes in chlor-alkali, acid, sulphur, glass, ceramic, and refractory industries.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Analyze manufacturing processes and process flow sheets associated with cement, soaps, detergents, paints, petrochemical, synthetic fiber, industrial gas, and fuel gas industries.	PO2 (3) PO5 (2)	PSO1 (2) PSO2 (2)
CO4	Evaluate the operational performance, engineering challenges, and sustainability aspects of fertilizer and large-scale chemical manufacturing industries.	PO3 (2) PO6 (2)	PSO2 (2)
CO5	Design suitable process schemes and industrial manufacturing routes for chemical products based on technical, economic, and environmental considerations.	PO3 (3) PO5 (2) PO7 (1) PO9 (1) PO11 (1)	PSO2 (2) PSO3 (2)

CH25303	Material Technology	L	T	P	C
		3	0	0	3

Course Objective:
To provide comprehensive knowledge on structure, properties, characterization and selection of engineering materials for various industrial and engineering applications.

Crystalline Solids: Crystal structures and crystal system, reciprocal lattice, miller indices, closed packed structures, determination of crystal structures. Imperfection in Solid - Point imperfections and their equilibrium concentration, Edge and screw dislocations; burgers vector and the dislocations; burgers vector and the dislocation leap, stress fields and energies of dislocations, dislocations forces, dislocation sources; Multiplication of dislocations.

Activities: Analyze crystal structures and crystal defects using lattice models, identify different imperfections in solids and evaluate their influence on material properties, solve problems related to Miller indices and dislocation mechanisms.

Mechanical Properties: The elastic properties, model of elastic behaviour, plastic deformation tensile stress-strain curve, shear strength of perfect and real crystals, mechanical failure, fatigue and fracture, creeps: mechanism of creep, characterization of creep curves. Hardness tests, Compression test, Tension test on different types of materials.

Activities: Interpret stress-strain behavior of materials, perform analysis of tensile, compression and hardness test data, evaluate mechanisms of creep, fatigue and fracture in engineering materials.

Electrical Properties: Classical and quantum theory of free electronics; relaxation time, collision time and mean free path, density of energy states and Fermi energy, electron motion under periodic potential, origin of energy bands in solids, classification of material on the basis of band gap, effective mass, intrinsic and extrinsic semi-conductors, hall effect and its applications. Measurement of capacitance of materials, Characterization of semiconductor material by FESEM and DLS. Band gap estimation from the band edge.

Activities: Analyze electronic band structures and semiconductor properties from literature, interpret Hall effect measurements and band gap estimation, evaluate characterization techniques such as FESEM and DLS for semiconductor materials.

Dielectric Properties: Mechanism of polarization concept of polarizability and internal fields, dielectrics in alternating field; frequency dependence of polarizability. Measurement of volume and surface resistivity- polarisation index of dielectric materials.

Activities: Evaluate dielectric behavior under alternating electric fields, analyze polarization mechanisms and resistivity measurements, compare dielectric properties of engineering insulating materials.

Magnetic Properties and Super Conductivity: Magnetic moments and its origin, dia-and para-magnetism, ferro and ferri-magnetism, soft and hard magnetic materials, ferrites, application of magnetic materials. Super conductivity - Properties of superconductors, London equations, Josephson effect, quantum explanation of super conductivity, flux quantization, application of superconductors. Conductivity measurements of materials. Fabrication and capacitance measurement of super capacitor.

Activities: Differentiate magnetic materials based on their properties and applications, analyze superconducting phenomena and flux quantization, interpret conductivity and capacitance measurements of advanced materials and super capacitors.

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

Assessment Methodology: Assignments (20%), Material characterization and problem-solving exercises (20%), Quiz / MCQs (20%), Internal Examinations (40%).

References:

1. Callister W. D., Jr. “Materials Science and Engineering”, John Wiley and Sons, Inc. New York, (2010).
2. Dekker A. J., “Solid State Physics”, Macmillan, India Limited, Madras, (2008).
3. Azaroff L. V., “Introduction to Solid”, Tata Mc Graw Hill, New Delhi, (2017).
4. Raghvan V., “Material Science and Engineering”, Prentice Hall of India, New Delhi, (2016).
5. Kittal, “Solid State Physics”, Wiley Eastern Limited, New Delhi, (2018).

E-Resources:

1. NPTEL Courses on Material Science and Engineering.
2. SWAYAM online learning resources on solid state physics and materials characterization.
3. Virtual laboratory resources for material testing and characterization techniques.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand crystal structures, lattice systems, crystal imperfections, and their influence on material properties.	–	–
CO2	Apply principles of material behavior to determine mechanical properties, strength, and failure characteristics under different loading conditions.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Analyze electronic energy states, semiconductor behavior, and band gap characteristics of engineering materials.	PO2 (3) PO4 (2)	PSO1 (2) PSO2 (1)
CO4	Evaluate the suitability of dielectric and magnetic materials for industrial and engineering applications.	PO3 (2) PO5 (2)	PSO2 (2)
CO5	Design material selection strategies using superconducting, conducting, dielectric, and magnetic materials for advanced technological applications.	PO3 (3) PO5 (3) PO6 (1) PO11 (2)	PSO2 (2) PSO3 (2)

CH25C02	Mechanical Operations	L	T	P	C
		3	0	2	4

Course Objectives:

To impart knowledge on particulate properties, size reduction, solid-fluid separation, filtration operations and air pollution control equipment used in chemical process industries.

Particulate properties and screening: General characteristics of solids; Characterization of solid particles; Differential and cumulative size analysis; Screening methods and equipment; Screen efficiency.

Practicals: Screen efficiency determination by sieve analysis

Activities: Evaluate screening equipment performance for industrial applications.

Size reduction and enlargement: Laws of size reduction and applicability; Energy relationship in size reduction; Power requirement; Work index; Method of size reduction; Types, classification and selection of size reduction equipments. Size enlargement and equipment.

Practicals: Work index, various constants and reduction ratio determination in Jaw Crusher/ Roll Crusher/ Ball mill/ Drop weight crusher

Activities: Analyze energy requirements for size reduction operations, compare different crushing and grinding equipment based on literature data.

Sedimentation and Elutriation: Theory and operation: Gravity settling; Sedimentation; Thickening; Elutriation.

Practicals: Batch Sedimentation studies; Characteristics of Elutriator

Activities: Interpret sedimentation dynamics for various particle sizes.

Filtration: Theory of filtration; classification of process; Flow through filter cake and filter media; filtration equipments – selection and operation.

Practicals: Filter characteristics of Plate and Frame Filter press / Leaf filter

Activities: Analyze selection and operation of industrial filtration equipment, compare filtration performance under different operating conditions.

Gas – Solid Separation - Industrial dust removing equipment; Electrostatic precipitators; Cyclone; Bag filters; Scrubbers.

Practicals: Efficiency calculation of cyclone separator

Activities: Analyze the working principles of air pollution control equipment, calculate collection efficiency of cyclone separators, evaluate suitable dust removal systems for industrial emission control.

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

Assessment Methodology: Assignments (20%), Experimental data analysis and equipment performance evaluation (20%), Quiz/ MCQs (20%), Internal Examinations (40%).

References:

1. McCabe, W.L., Smith,J.C., and Harriot,P., “Unit Operations in Chemical Engineering”, 7th Edition., McGraw-Hill, 2005. ISBN: 9780072848236
2. Badger W.L. and Banchero J.T.,“Introduction to Chemical Engineering”, Indian edition, TataMcGrawHill, 2017. ISBN: 9780074630501
3. Martin Rhodes, “ Introduction to particle technology”, wiley , 2nd edition., 2013. ISBN: 9781118681541Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. I,6th Edition., Elsevier,1999. ISBN: 0750644443
4. Coulson, J.M. and Richardson, J.F., “Chemical Engineering”, Vol. I, 6th Edition, Elsevier, 1999. ISBN: 0750644443.
5. Green, Don W., and Marylee Z. Southard, “Perry's Chemical Engineers' Handbook” 9th edition. McGraw hill, 2019. ISBN: 9780071834087
6. C M Narayanan and B.C. Bhattacharya: “Mechanical Operation for Chemical Engineers (with computer aided analysis)” 3rd Edition, Khanna publishers. 1990. ISBN: 9788174090362.
7. Foust,A.S.,Wenzel,L.A.,Clump,C.W.,Naus,L.,and Anderson,L.B., “Principles of Unit Operations”,2nd edition, Wiley.,2008. ISBN:978-8126518296
8. Brown, G.G. and associates, “Unit operations” 1st edition, Wiley, 1950. ISBN: 978-8123910994

E-Resources:

1. NPTEL courses on Mechanical Operations and Particle Technology.
2. SWAYAM online resources for Unit Operations in Chemical Engineering.
3. Virtual laboratory simulations on screening, crushing, filtration and sedimentation operations.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand particulate properties, particle size analysis, and screening operations used in solid particle processing industries.	–	–
CO2	Apply principles of size reduction to determine energy requirements and performance of comminution equipment.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Analyze sedimentation, thickening, and elutriation processes employed for solid–fluid separation.	PO2 (3) PO4 (2)	PSO1 (2)
CO4	Evaluate filtration mechanisms and the suitability of filtration equipment for industrial applications.	PO3 (3) PO5 (2)	PSO2 (2)
CO5	Design solid processing and air pollution control systems by selecting appropriate separation and particulate control equipment for process industries.	PO3 (3) PO6 (3) PO7 (2) PO11 (1)	PSO2 (2) PSO3 (2)

CH25C03	Fluid Mechanics	L	T	P	C
		3	0	2	4

Course Objectives:

To provide knowledge on fluid behavior, fluid flow analysis, pressure drop estimation, flow measurement techniques, and performance characteristics of fluid handling equipment used in chemical engineering applications.

Introduction to Types of Fluids - Fluids - Properties, Methods of analysis and description - fluid as a continuum – Velocity and stress field - Newtonian and non-Newtonian fluids – Classification of fluid motion.

Activities: Graphical representation of experimental rheological data

Dimensional Analysis and Similitude: The principle of dimensional homogeneity – dimensional analysis, Rayleigh method and the Pi- theorem - non-dimensional action of the basic equations - similitude – relationship between dimensional analysis and similitude - use of dimensional analysis for scale up studies

Activities: Apply dimensional analysis techniques to engineering problems, explore and list dimensionless numbers from allied engineering disciplines, evaluate similitude criteria for scale-up studies using dimensionless numbers.

Fluid Statics And Kinematics: Fluid statics – basic equation - equilibrium of fluid element – pressure variation in a static fluid - application to manometer – Differential analysis of fluid motion – continuity, equation of motions, Bernoulli equation and Navier- Stokes equation.

Activities: Solve problems based on continuity equation, Navier-Stokes equation and Bernoulli equation problems.

Characteristics of Internal and External Flows: Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions – major and minor losses; External flows - boundary layer concepts, boundary layer thickness under laminar and turbulent flow conditions- Flow over a sphere – friction and pressure drag - flow through fixed and fluidized beds.

Practicals:

1. Flow through pipes (Straight pipe / Annular pipe)
2. Flow through helical coil and spiral coil
3. Pressure drop studies in packed bed columns
4. Pressure drop studies in fluidized bed column

Activities: Compare laminar and turbulent flow characteristics in engineering applications.

Flow Measurements and Metering: Flow measurement - Constant and variable head meters; Velocity measurement techniques; Type and characteristics of valves; Classification, performance characteristics of pumps.

Practicals:

1. Calibration of variable head flow meters (Orifice meter / Venturi meter)
2. Characteristic curves of pumps (Centrifugal / Reciprocating)

Activities:

Analyze and interpret pump performance curves.

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

Assessment Methodology: Assignments (20%), Experimental data analysis and numerical problem solving (20%), Quiz/MCQs (20%), Internal Examinations (40%).

References:

1. Y. Cengel and J. Kimbala, Fluid Mechanics: Fundamentals and Applications, McGraw Hill Publication, 3rd Ed., 2014. ISBN 978-1-259-69653-4
2. Noel de Nevers, “Fluid Mechanics for Chemical Engineers “, Second Edition, McGraw-Hill, (1991). ISBN-13: 978-0071008303 ISBN-10: 0071008306.
3. R. W. Fox and A. T. McDonald, Introduction to Fluid Mechanics, Wiley India Edition, John Wiley & Sons, 2015. ISBN-10. 9780470547557 ; ISBN-13. 978-0470547557
4. W. M. Deen, Introduction to Chemical Engineering Fluid Mechanics, Cambridge University Press, New York, 2016.
5. F. M. White, Fluid Mechanics, 8th Ed., McGraw Hill Publications, 2017.
6. W. L. McCabe, J. Smith and P. Harriot, Unit Operations of Chemical Engineering, 7th Ed., McGraw - Hill, International Edition, 2014.

E-Resources:

1. NPTEL courses on Fluid Mechanics and Chemical Engineering Fluid Flow.
2. SWAYAM online modules for fluid flow operations and fluid machinery.
3. Virtual laboratory simulations for flow measurement and fluid transport systems.

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand fluid properties, fluid statics, and stress–strain relationships under static conditions.	PO1(3)	PSO1(2)
CO2	Apply dimensional analysis and similitude principles to develop engineering correlations and scale-up relationships.	PO1(3), PO2(2)	PSO2(2)
CO3	Analyze fluid flow behavior using continuity, Bernoulli, and Navier–Stokes equations.	PO2(3), PO4(2)	PSO1(2), PSO2(2)
CO4	Evaluate the performance of internal and external flow systems, including pipes, packed beds, and fluidized beds under varying operating conditions.	PO3(3), PO4(2)	PSO1(2), PSO2(2)
CO5	Design and assess fluid transport systems by selecting suitable flow measuring devices, pumps, and valves for chemical engineering applications.	PO3(3), PO5(3), PO11(2)	PSO2(3), PSO3(3)

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

Course Objectives:

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

List of Activities

A. Elements of Effective Speaking and Listening

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

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

(iii) Welcoming a Guest Speaker at a Seminar

(iv) Pictography to represent data using images or symbols

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

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication

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

(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

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

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

(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries

(ii) Social Media Optimisation

(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

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

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

F. Mock Interviews and Communication Strategies:
(i) Listening – Job interview

(ii) Speaking – Mock interviews

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

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

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

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

CO Mapping with PO & PSO

	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

CH25C04	Chemical Reaction Engineering I	L	T	P	C
		3	0	2	4

Course Objectives:
To provide knowledge on reaction kinetics, design and analysis of homogeneous reactors, multiple reactions, non-isothermal reactor operation and residence time distribution in ideal and non-ideal reactors.

Kinetics of Homogenous Reaction: Rate equation; elementary; non-elementary reactions; theories of reaction rate and Prediction. Design equation for constant and variable volume batch reactors, Concentration dependency of rate constant; Temperature dependency of rate constant. Analysis of batch experimental data using integral and differential analysis. Half-life calculation

Practicals:
1.Kinetic studies in a Batch reactor, semi batch reactor
2. Determination of Activation Energy

Activities: Analyze homogeneous reaction kinetics using experimental data, evaluate rate constants and activation energy.

Ideal Reactors: Ideal reactor classification. Design of continuous reactors under steady state operation -stirred tank and tubular reactor; recycle reactors; combination of reactors and size comparison of reactors.

Practicals:
1. Kinetic studies and conversion calculation in a Plug flow reactor
2. Kinetic studies and conversion calculation in a CSTR
3. Conversion calculation PFR followed by a CSTR

Activities: Evaluate conversion and performance of ideal reactors, compare reactor configurations and sizing.

Multiple Reactions: Design of reactors for multiple reactions - consecutive, parallel and mixed reactions. Factors affecting choice, optimum yield and conversion in CSTR, PFR; selectivity and yield.

Activities: Analyze reactor performance for multiple reactions, evaluate selectivity and yield for parallel and consecutive reactions, determine optimum reactor conditions for maximum conversion.

Non-Isothermal Reactors: 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.

Practicals:

1. Kinetic studies of Adiabatic Reactor

Activities: Analyze heat effects in chemical reactors, evaluate reactor performance under non-isothermal conditions, determine optimum temperature progression in reactor operation.

Non-Ideal Reactors: The residence time distribution for chemical reactors, residence time functions and relationship between them in reactor; Different models used in non-ideal reactors, conversion calculation using different models in non-ideal reactors.

Practicals:

1. RTD studies in PFR
2. RTD studies in CSTR

Activities: Evaluate residence time distribution functions, analyze reactor non-idealities using RTD models, compare conversion behavior in ideal and non-ideal reactor systems.

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

Assessment Methodology:

Assignments (20%), Experimental data analysis and reactor simulations (20%), Solving Quiz/MCQs (20%), Internal Examinations (40%).

References:

1. Levenspiel. O., Chemical Reaction Engineering, Third Edition, John Wiley, 1999. ISBN: 9971512416
2. Fogler H.S., Elements of Chemical Reaction Engineering, Third Edition, Prentice Hall of India, 1999. ISBN: 8120322347
3. J.M.Smith Chemical Engineering Kinetics, Third Edition, Mc Graw Hill New York 1981 ISBN:0070587108
4. Lanny D. Schmidth, The Engineering of Chemical Reactions, Second Edition, Oxford University Press, 2005. ISBN: 0195169255
5. Hayes, R.E., Mmbaga J.P., Introduction to chemical reactor analysis, second edition, CRC Publisher,2012. ISBN 9781439867006
6. Doraiswamy, L.K., DenizUner, Chemical Reaction Engineering Beyond the fundamentals, first edition, CRC Press , 2014. ISBN: 978-1439831229
7. Fronment, G.F.,.Bischoff K.B., Chemical Reactor Analysis and Design , Third Edition, John Wiley and Sons, 2011. ISBN: 978-0-470-56541-4

E-Resources:

1. NPTEL courses on Chemical Reaction Engineering and Reactor Design.
2. SWAYAM online resources for reaction kinetics and reactor analysis.
3. Virtual laboratory simulations for reactor performance and RTD analysis.

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles of homogeneous reaction kinetics and factors influencing reaction rates.	PO1(3)	PSO1(2)
CO2	Apply reactor performance equations to determine conversion and design parameters for ideal reactor systems.	PO1(3), PO2(2)	PSO1(2)
CO3	Analyze multiple reaction systems to determine selectivity, yield, and conversion behavior in chemical reactors.	PO2(3), PO4(2)	PSO1(2), PSO2(1)
CO4	Evaluate the operation and thermal performance of non-isothermal reactors under varying operating conditions.	PO3(3), PO5(2)	PSO2(2)
CO5	Design and assess reactor systems by incorporating residence time distribution models and non-ideal flow behavior.	PO3(3), PO5(3), PO11(2)	PSO2(2), PSO3(3)

CH25401	Chemical Engineering Thermodynamics II	L	T	P	C
		3	0	0	3

Course Objectives:

To provide comprehensive knowledge on solution thermodynamics, phase equilibria, chemical reaction equilibrium and refrigeration systems for chemical engineering applications.

Solution Thermodynamics: Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures, pure species and liquids.

Activities: Solving problems on ideal and non-ideal solution behavior, apply Gibbs-Duhem equation for thermodynamic property estimation.

Phase Equilibrium: Phase equilibrium in ideal solution, excess Gibbs free energy models, Henry's law, fugacity, phase diagrams for homogeneous systems and for systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

Activities: Interpret phase diagrams and azeotropic behavior, analyze vapor-liquid and liquid-liquid equilibrium systems.

Vapor-Liquid Equilibrium: Vapor-liquid equilibrium at low, moderate and high pressures; bubble and dew point calculation, thermodynamic consistency test of VLE data.

Activities: Perform bubble point and dew point calculations, analyze VLE behavior under varying pressure conditions.

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

Activities: Analyze equilibrium conversion for homogeneous reactions, evaluate the effect of temperature on equilibrium constants, solve reaction equilibrium problems for gas and liquid phase systems.

Refrigeration and Liquefaction: Principles of refrigeration, methods of producing refrigeration, liquefaction process, coefficient of performance, evaluation and performance of vapor compression and gas refrigeration cycles

.

Activities: Analyze liquefaction and vapor compression systems, compare coefficient of performance of refrigeration processes under different operating conditions.

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

Assessment Methodology: Assignments (20%), Problem-solving using thermodynamic models and software tools (20%), Quiz / MCQs (20%), Internal Examinations (40%).

References:

1. Smith J.M., VanNess,H.C., &Abbot M.C," Introduction to Chemical Engineering Thermodynamics", McGraw Hill VII Edition 2009
2. Narayanan K.V"A Text Book of Chemical Engineering Thermodynamics " Prentice Hall of India Pvt.Ltd,2 nd edition, 2013..
3. Sandler,S.I.,"Chemical and Engineering Thermodynamics", IV Edition, Wiley,2006
4. Rao Y.V.C.,"Chemical Engineering Thermodynamics" Universities Press, 2005
5. Koretsky., Engineering and Chemical thermodynamics, Wiley,2011
6. Kyle B.G., "Chemical and Process Thermodynamics", Pearson International third Edition.
7. Kevin Douglas, Fundamentals of Chemical Engineering Thermodynamics, Timothy Anderson,2015

E-Resources:

1. NPTEL courses on Chemical Engineering Thermodynamics and Phase Equilibrium.
2. SWAYAM online modules on solution thermodynamics and refrigeration systems.
3. Thermodynamic property databases and simulation tools for VLE and equilibrium analysis.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand partial molar properties and the thermodynamic behavior of ideal and non-ideal solutions.	–	–
CO2	Apply vapor–liquid equilibrium principles for bubble point, dew point, flash, and consistency calculations.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Analyze phase equilibrium behavior using thermodynamic models, activity coefficient models, and phase diagrams.	PO2 (3) PO4 (2)	PSO1 (2) PSO2 (1)
CO4	Evaluate chemical reaction equilibria and the influence of temperature and operating conditions on equilibrium conversion.	PO3 (3) PO5 (2)	PSO2 (2)
CO5	Design refrigeration and liquefaction systems based on thermodynamic principles, performance analysis, and energy efficiency considerations.	PO3 (3) PO5 (2) PO6 (1) PO11 (1)	PSO1 (2) PSO2 (2) PSO3 (1)

CH25C05	Mass Transfer I	L	T	P	C
		3	0	2	4

Course Objectives:
To provide knowledge on diffusion, convective and interphase mass transfer, humidification, drying and crystallization processes used in chemical engineering industries.

Molecular Diffusion: Introduction and overview of mass transfer operations; Molecular and eddy diffusion, Diffusion velocity and fluxes, Fick's first and second law, Steady state molecular diffusion in fluids under stagnant and laminar flow conditions, Diffusion through variable cross sectional area, Diffusivity measurement and prediction; Multi-component diffusion, Diffusivity in solids.

Practicals:
1. Measurement of diffusivity
2. Paper-based microfluidic diffusion studies and viscosity estimation using Lucas–Washburn equation (e.g. Kaappon Analytics experimental module)

Activities: Problem solving on diffusion.

Convective Mass Transfer And Interphase Mass Transfer: Mass transfer coefficient concept and its types, Dimensionless groups and correlation for convective mass transfer coefficients, Mass transfer coefficient in laminar flow, Turbulent or Eddy diffusion, Theories of mass transfer; Momentum, Heat and Mass Transfer Analogies; Interphase mass transfer: Equilibrium and mass transfer between phases, the two resistance theory; Method of contacting the phases - Stage-wise and differential contractors.

Practicals:
1. Solid Liquid mass transfer studies
2. Determination of mass transfer coefficient for surface evaporation
3. Colorimetric detection and concentration estimation using paper-based microfluidic devices (e.g. Kaappon Analytics module)

Activities: Application of transport analogies to practical engineering systems.

Humidification And Cooling Tower: Vapour – liquid equilibrium and enthalpy for a pure substance, Terminologies and Definitions, Humidity chart and its use, Adiabatic Saturation Temperature, Wet bulb temperature; Cooling towers - Types, construction, operation and design calculations; Adiabatic humidification; Dehumidification.

Practicals: Wetted wall column / Estimation of mass and heat transfer coefficient for cooling tower

Activities: Interpret psychrometric properties using humidity charts, analyze cooling tower operations and humidification processes, evaluate simultaneous heat and mass transfer phenomena.

Drying: Mechanism of drying and drying Equilibria, Classification of dryers, Drying Behaviour; Batch drying - Mechanism and calculation of drying rate and time, Through Circulation drying in packed beds; Continuous dryers – material and energy balance, Estimation of drying time, Preliminary design of a rotary dryer, Advance drying techniques such as freeze drying, dielectric and microwave drying.

Practicals: Drying characteristics of forced draft dryer
Activities: Analyze drying characteristics and drying rate curves, perform material and energy balance on drying systems, compare conventional and advanced drying techniques.

Crystallization: Crystal geometry, Solid – liquid phase equilibrium, yield and purity of products; Heat effects in crystallization process; Theory of super saturation, nucleation and crystal growth; Crystal size distribution – The MSMPR crystallizer; Classification of crystallizers, Design consideration of batch and continuous crystallizers.

Practicals: Analyze nucleation and crystal growth kinetics, evaluate crystallizer performance based on yield and purity, literature study on recent crystallization techniques.

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

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

References:

1. Geankoplis, C.J., “Transport Processes and Unit Operations”, 4th Edition, Prentice Hall Inc., NewJersey, 2015, ISBN 8120326418.
2. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. 1 : Fluid Flow, Heat Transfer and Mass Transfer, 6th Edition, Btterworth-Heinemann, 1999, ISBN-13: 978-0750644440 ISBN-10: 0750644443.
3. Coulson, J.M. and Richardson, J.F., “Chemical Engineering” Vol. 2 : Particle Technology and Separation Processes, 5th Edition, Btterworth-Heinemann, 2007, ISBN-13: 9780750644457, ISBN-10: 0750644451.
4. Welty, JR ,Wicks, C E and Wilson, R E., Fundamentals of Momentum, Heat and Mass Transfer, 5th Edition, John wiley and sons, 2008, ISBN-10: 0470128682, ISBN-13: 978-0470128688

E-Resources:
NPTEL Links

1. NPTEL course on Mass Transfer Operations.
2. NPTEL course on Transport Phenomena.
3. SWAYAM online modules on drying, humidification and crystallization.
4. Virtual laboratory simulations for mass transfer operations and cooling towers.

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand diffusion mechanisms in fluids and solids and the factors influencing mass transfer processes.	PO1(3)	PSO1(2)
CO2	Apply theories of convective and interphase mass transfer to determine mass transfer coefficients in engineering systems.	PO1(3), PO2(2)	PSO1(2), PSO2(1)
CO3	Analyze humidification and cooling tower operations involving simultaneous heat and mass transfer phenomena.	PO2(3), PO4(2)	PSO1(2), PSO2(2)
CO4	Evaluate drying mechanisms, drying characteristics, and the performance of industrial drying equipment.	PO3(3), PO5(2)	PSO2(2)
CO5	Design and assess crystallization systems by integrating nucleation, crystal growth, and crystallizer performance parameters.	PO3(3), PO5(3), PO11(2)	PSO2(2), PSO3(3)

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: 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	Understand the fundamental principles of conduction heat transfer under steady and transient conditions in different geometries.	–	–
CO2	Apply convective heat transfer correlations to determine heat transfer coefficients for internal and external flow systems.	PO1 (3) PO2 (2)	PSO1 (2)
CO3	Analyze heat exchanger performance using LMTD and effectiveness–NTU methods.	PO2 (3) PO4 (2)	PSO1 (2) PSO2 (1)
CO4	Evaluate boiling, condensation, and evaporation processes used in industrial heat transfer applications.	PO3 (3) PO5 (2)	PSO2 (2)
CO5	Design heat transfer systems involving radiation, packed beds, and fluidized beds for efficient industrial operation.	PO3 (3) PO5 (2) PO6 (1) PO11 (1)	PSO1 (2) PSO2 (2) PSO3 (1)

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

Course Objective: To provide knowledge on industrial standards, engineering symbols, process equipment standards, and valve and instrumentation standards used in chemical process industries.

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: Analyze the role of standardization in process industries, interpret BIS and ISO standards relevant to chemical engineering, evaluate the importance of standards in industrial safety, sustainability and trade.

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: Interpret process flow diagrams and piping & instrumentation diagrams, identify standard symbols and color codes used in process industries, prepare simple industrial process flow sheets using standard conventions.

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: Analyze standards related to process equipment sizing and selection, interpret equipment datasheets and specifications, evaluate standard dimensions and capacities of industrial process equipment.

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.

Activities: Identify standard valve specifications and marking systems, analyze valve selection criteria for process industries, evaluate instrumentation symbols and control functions used in process control systems.
Process Measurement, Control Functions and Instrumentation: Process measurement control functions and instrumentation - symbolic representation, Part 1 to 4. **Activities:** Interpret instrumentation symbols and control loop representations, analyze process measurement and control functions, apply standard instrumentation conventions in process industries.
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%.
Assessment Methodology: Assignments (20%), Standards interpretation and symbol identification exercises (20%), Case studies on industrial equipment and instrumentation standards (20%), Internal Examinations (40%).
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. Bureau of Indian Standards (BIS) online resources and publications. 2. ISO and IEC standards documentation portals. 3. NPTEL lectures on Process Equipment Design and Instrumentation.

CO Mapping with PO & 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)

CH25C08	Process Dynamics and Control	L	T	P	C
		3	0	2	4

Course Objectives: To provide knowledge on process dynamics, mathematical modeling, controller design, stability analysis and advanced process control strategies used in chemical process industries.

Basics of Process Control: Process instrumentation - Need of measuring instruments, performance characteristics - static and dynamic, principal measuring instruments - pressure, temperature, flow rate, liquid level, pH and concentration; Laplace transforms - properties of Laplace transforms, solution of ODE using Laplace transforms, forcing functions.

Activities: Analyze the characteristics and applications of industrial measuring instruments, apply Laplace transforms for solving process dynamic equations.

Open Loop Systems: Introduction to chemical process control; formulating process models using transfer function approach; Open-loop systems - first order systems and their transient response for standard inputs, first order systems in series, linearization and its application in process control; second order systems and their dynamics; transportation lag-first order and second order Pade approximation.

Activities: Develop transfer function models for process systems, analyze transient response of first and second order systems, evaluate transportation lag effects and linearization techniques in process control applications.

Closed Loop Systems: Closed loop control systems - development of block diagram, servo and regulatory problems, transfer function for controllers and final control element - Types of control valve - sizing & characteristics, modes of control action - ON/OFF, P, PI, PD, PID and their characteristics, transient response of closed-loop control systems, stability analysis using Routh’s test.

Activities: Analyze closed loop control system performance, evaluate controller tuning and control valve characteristics, determine system stability using Routh stability criterion.

Control System Design by Frequency Response: Introduction to frequency response of closed-loop systems, control system design by frequency response techniques, bode diagram, stability criterion, tuning of controllers - Ziegler Nichols and Cohen-Coon tuning methods.

Activities: Interpret frequency response characteristics using Bode plots, analyze stability using frequency domain techniques, compare controller tuning methods for process control systems.

Digital Control Systems: Introduction to advanced control systems - cascade control, feed forward control, ratio control, multivariable control; Introduction to digital control,

Programmable Logic Controller (PLC), Distributed Control System (DCS), SCADA.

Activities: Analyze advanced process control strategies, evaluate digital control architectures such as PLC, DCS and SCADA, compare conventional and computer-based process control systems.

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

Assessment Methodology: Assignments (20%), Experimental data analysis and numerical problem solving (20%), Quiz/MCQs (20%), Internal Examinations (40%).

References:

1. Stephanopoulos G., “Chemical Process Control”, Vol. 2, Prentice Hall, 1984. ISBN: 9789332549463.
2. Ogunnaike B.A. and Ray W.H., “Process Dynamics, Modeling and Control”, Oxford University Press, 1994. ISBN: 9780195091199.
3. Coughanowr D.R. and LeBlanc S.E., “Process Systems Analysis and Control”, 3rd Edition, McGraw-Hill, 2008. ISBN: 9780073397894.
4. Bequette B.W., “Process Control: Modeling, Design and Simulation”, Prentice Hall Professional, 2003.
5. Seborg D.E., Mellichamp D.A., Edgar T.F. and Doyle F.J., “Process Dynamics and Control”, John Wiley & Sons, 2010.
6. Riggs J.B. and Karim M.N., “Chemical and Bio-process Control”, Prentice Hall, 2006.
7. Luyben W.L., Tyreus B.D. and Luyben M.L., “Plantwide Process Control”, McGraw-Hill, 1998.
8. Peter Harriott, “Process Control”, McGraw-Hill, 1964.

E-Resources:

1. NPTEL course on Process Dynamics and Control.
2. NPTEL course on Chemical Process Control and Instrumentation.
3. SWAYAM online modules on process automation and controller tuning.
4. Industrial case studies on PLC, DCS and SCADA systems.

CO Mapping with PO & PSO:

CO	CO Description	PO Mapping	PSO Mapping
CO1	Understand process instrumentation systems, measurement principles, and dynamic characteristics of process variables.	–	–
CO2	Apply transfer function models to determine the open-loop dynamic response of process systems.	PO1(3) PO2(2)	PSO1 (2)
CO3	Analyze closed-loop control systems, controller actions, and stability characteristics of process control systems.	PO2(3) PO4(2)	PSO1 (2) PSO2 (1)
CO4	Evaluate frequency response methods and controller tuning techniques for effective process control applications.	PO3(3) PO5(2)	PSO2 (2)
CO5	Design advanced and digital control systems for modern process industries by integrating control strategies and automation tools.	PO3(3) PO5(3) PO11(1)	PSO2 (2) PSO3 (2)

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

Course Objectives:

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

List of Activities

Stage Ready – Impactful Public Speaking.

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

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

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

Professional and Application-Oriented Writing

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

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

Receptive Skills in Workplace Communication·

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

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

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

Intercultural Communication

(i) Assertive vs Aggressive communication

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

From Campus to Career: Industry Skills and Global Exam Preparation

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

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

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

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

End Semester Assessment:

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

References:

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

E-resources:

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

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