ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B.Tech. Pharmaceutical Technology **Regulations:** 2025

Abbreviations:

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

BS – Basic Science (Mathematics, Physics, Chemistry)

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

SD – Skill Development

SL – Self Learning

CDP – Capstone Design Project

OE – Open Elective

L – Laboratory Course

T – Theory

LIT – Laboratory Integrated Theory

PW – Project Work

IPW – Internship cum Project Work

DIC – Department Introductory Course

TCP – Total Contact Period(s)

Program Outcomes

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

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

Program Specific Outcomes:

PSO 1: Design, develop, and manufacture safe, effective, and high-quality drug products.

PSO 2: Acquire modern software tools for addressing complex problems in the field of pharmaceutical sectors.

PSO 3: Exhibit professional ethics, team works, research aptitude while complaining stringent regulations in pharmaceutical sectors.

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.	PH25C01	Applied Physics - I	LIT	2-0-2	4	3	BS
5.	CY25C01	Applied Chemistry - I	LIT	2-0-2	4	3	BS
6.	PY25C01	Introduction to Pharmaceutical Technology	T	2-1-0	3	3	ES (PC)
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	**33**	**23**	

Semester – II							
S. No	**Course Code**	**Course Name**	**Course Type**	**Periods/ Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.	MA25C02	Linear Algebra	T	3-1-0	4	4	BS
2.	ME25C03	Introduction to Mechanical Engineering	T	2-1-0	3	3	ES (PC)
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.	PH25C06	Applied Physics (Tech) - II	T	2-1-0	3	3	BS
6.	ME25C01	Engineering Drawing	LIT	2-0-4	6	4	ES (G)
7.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
8.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
9.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
10.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
11.		Foreign Language^	LIT	1-0-2	3	1	HUM
				TOTAL	**37**	**25**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No	**Course Code**	**Course Name**	**Course Typ#**	**Periods/ Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1	MA25C09	Computational Differential Equations	T	3-1-0	4	4	BS
2	PY25301	Pharmaceutical Biochemistry	T	3-0-0	3	3	ES (PC)
3	PY25302	Human Anatomy and Physiology	T	3-0-0	3	3	ES (PC)
4	PY25303	Pharmaceutical Chemistry	LIT	3-0-2	5	4	ES (PC)
5	PY25304	Physical Pharmaceutics	LIT	3-0-2	5	4	ES (PC)
6	EN25C03	English Communication Skills Laboratory – I	L	0-0-2	2	1	HUM
7	-	Skill Development Course – I	LIT	1-0-2	3	2	SD
8	PY25305	Biochemistry and Physiology Laboratory	L	0-0-4	4	2	ES (PC)
				TOTAL	**29**	**23**	

Semester – IV							
S. No	**Course Code**	**Course Name**	**Course Type#**	**Periods/Week**		**Credits**	**Category**
				L-T-P	**TCP***		
1	PY25401	Pharmaceutical Microbiology	LIT	3-0-2	5	4	ES (PC)
2	PY25402	Cell and Molecular Biology	T	3-0-0	3	3	ES (PC)
3	PY25403	Chemical Process Calculations and Fluid Flow Operations	LIT	3-0-2	5	4	ES (PC)
4	PY25404	Pharmaceutical Analysis	T	3-0-0	3	3	ES (PC)
5	PY25405	Dosage forms Technology - I	T	3-0-0	3	3	ES (PC)
6	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
7	-	Skill Development Course – II	LIT	1-0-2	3	2	SD
8	PY25406	Introduction to Standards in Pharmaceutical Technology	T	1-0-0	1	1	ES (PC)
9	-	Industry Internship (4 weeks)*	L	-	-	-	IPW
				TOTAL	**25**	**21**	

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.		Pharmacology and Toxicology	T	3-0-0	3	3	ES (PC)
2.		Unit Operations in Pharmaceutical Industries	T	3-1-0	4	4	ES (PC)
3.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
4.		Programme Elective – II	T	3-0-0	3	3	ES (PE)
5.		Dosage forms Technology-II	LIT	3-0-2	5	4	ES (PC)
6.		Skill Development Course–III	LIT	1-0-2	3	2	SD
7.		Industry Oriented Course– I	LIT	1-0-2	3	1	SD
8.		Pharmacology and Toxicology Lab	L	0-0-4	4	2	ES (PC)
9.		Industry Internship*	-	-	-	2	IPW
			Total Credits		**28**	**24**	
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	

*Four weeks industrial training/internship carries two credits. Industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester

Semester – VI							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1.	PY25401	Heat and Mass Transfer Operations	T	3-1-0	4	4	ES (PC)
2.	PY25402	Drug Regulatory Affairs	T	3-0-0	3	3	ES (PC)
3.	PY25403	Medicinal Chemistry	T	3-1-0	4	4	ES (PC)
4.		Programme Elective – III	T	3-0-0	3	3	ES (PE)
5.		Open Elective	T	3-0-0	3	3	ES (OE)
6.		Industry Oriented Course – II	LIT	1-0-2	3	1	SD
7.		Self-Learning Course	---	---	0	1	---
8.		Research Internship	L	-	-	-	IPW
			Total Credits		**20**	**19**	
For Honours Degree							
1.		Capstone Design Project – Level II	CDP	0-0-12	12	6	SDC
(OR)							
1.		Honours Elective – III	T	3-0-0	3	3	
2.		Honours Elective – IV	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – III	T	3-0-0	3	3	
2.		Minor Elective – IV	T	3-0-0	3	3	

Semester – VII							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T-P	**TCP**		
1		Engineering Entrepreneurship Development	T	2-0-2	4	3	HUM
2		Climate Change and Sustainability	T	2-0-0	2	2	HUM
3		Instrumental Methods of Pharmaceutical Analysis	T	3-1-0	4	4	ES (PC)
4		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
5		Programme Elective – V	T	3-0-0	3	3	ES (PE)
6		Project Management	T	2-0-0	2	2	HUM
7		Biopharmaceutics and Pharmacokinetics	LIT	3-0-2	5	4	ES (PC)
8		Instrumental Methods of Pharmaceutical Analysis Lab	L	0-0-4	4	2	ES (PC)
9		Research Internship	-	-	-	2	SD
Total Credits					**27**	**25**	
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: 168

PROFESSIONAL ELECTIVE COURSES – STREAMS

Pharmaceutical Manufacturing Technology	**Drug Discovery and Development**	**Pharmaceutical Management**	**Quality and Compliance**	**Digital Pharma and Smart Technologies**
Pharmaceutical Packaging Technology	Cheminformatics and Bioinformatics	Pharmaceutical Project Management	Validation in Pharmaceutical Industries	Metabolic Engineering
Process Development, Optimisation and Technology Transfer	Computer Aided Drug Design	Industrial Psychology and Human Resource Management	Quality Assurance	Systems Biology
Pharmaceutical Process Engineering	Herbal Technology	Pharmaceutical Production Management	Statistical Quality and Process Control	Digital Health Technologies
Lean manufacturing	Technology of Fine Chemicals and Bulk drugs	Safety and Disaster Management	Auditing and Compliance	Digital twins (AI-ML)
Novel Drug Delivery Systems	Clinical Research and Pharmacovigilance	Strategic and Operations Management	Quality Management Systems	3D bioprinting
Applied Chemical Engineering Thermodynamics	Regulatory Toxicology	Pharmaceutical Supply Chain Management	Total Quality Management	Medical Devices, BioMEMS and Microfluidics

Semester I

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

References:

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

E-resources:

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

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

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.
2. Ron Larson and David C. Falvo,(2013), Calculus: an Applied Approach. Cengage Learning.
3. Stewart, J., Clegg, D., & Watson, S. (2019). *Calculus: Early transcendentals*.

4. Thomas, G. B., Jr., Weir, M. D., Hass, J., & Heil, C. (2018). *Thomas' calculus: Early transcendentals*. Pearson.
5. Singh, K. (2019). *Engineering mathematics through applications*. Bloomsbury Publishing.
6. Grewal, B. S. (2012). *Higher engineering mathematics.* Khanna Publishers.

E-resources:

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

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

UC25H01	தமிழர் மரபு	L	T	P	C
		1	0	0	1

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

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

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

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

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

References:

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Publishedby: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Bookand Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

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

Language and Literature: Language Families in India, Dravidian Languages, Tamil as 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, Leatherpuppetry, Silambattam, Valari, Tiger dance, Sports and Games of Tamils.

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

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

References:

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

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)

PY25C01	**Introduction to Pharmaceutical Technology**	L	T	P	C
		2	1	0	3

Course Objectives:

To introduce students to the basic concepts of pharmaceutical science and technology. To understand the types, methods, and significance of pharmaceutical dosage forms. To impart knowledge on formulation techniques, quality control, and regulatory aspects. To familiarize students with Good Manufacturing Practices (GMP) and industry standards.

Introduction to Pharmaceutical Technology: Evolution of Pharmacy and Pharmaceutical Sciences, Definition, scope, and significance of Pharmaceutical Technology, Overview of the global and Indian pharmaceutical industry - Drug development lifecycle: Discovery to marketing

Activity: Report preparation on Overview of the global and Indian pharmaceutical industry.

Dosage Forms and Excipients (introductory): Basic pharmaceutical terms: API, excipients. Dosage forms - Classification of dosage forms: solid, liquid, semisolid, sterile - Conventional, sustained-release, and novel drug delivery systems - Role and examples of excipients in formulations

Activity: Demonstration on API, excipients and their significance on dosage.

Pharmaceutical Unit Operations (introductory), Principles and equipment: Mixing, Milling, Drying, Granulation, Coating, Tablet compression and capsule filling stages - Filtration and sterilization techniques

Activity: Virtual demonstration on various equipments for Pharmaceutical Unit Operations.

Physicochemical & Stability Aspects (introductory treatment), Solubility and pKa, Polymorphism and its implications, Drug-excipient compatibility studies, Stability testing: real-time and accelerated; Shelf-life estimation

Activity: Calculation for solubility and pKa determination.

Quality, GMP, Introduction to Quality Control (QC) and Quality Assurance (QA), Good Manufacturing Practices (GMP), overview, Validation and documentation basics - Packaging and labeling requirements

Activity: Report preparation on Quality Control and Quality Assurance.

References:

1. Carter, S. J. (2008). Cooper and Gunn's dispensing for pharmaceutical students. CBS Publishers.
2. Popovich, L. V. N. G., & Ansel, H. C. (2011). Ansel's pharmaceutical dosage form and drug delivery system. Lippincott Williams and Wilkins.
3. Thombre, N., Mahajan, H., Chaudhari, S., Shaikh, K., & Karuppaiyan, K. (2022). Concepts of industrial pharmacy-I. Pharma Career Publications.
4. Aulton, M. E., & Taylor, K. M. G. (2018). Aulton's pharmaceutics: The design and manufacture of medicines. Elsevier.

5. Khar, R. K., Vyas, S. P., Ahmad, F. J., & Jain, G. K. (2020). Lachmann Lieberman's theory and practice of industrial pharmacy (4th ed.). CBS Publisher and Distributor.
6. Gennaro, A. R. (2005). Remington: The science and practice of pharmacy. Lippincott Williams.

	Description of CO	**PO**	**PSO**
CO1	Explain basic pharmaceutical terminologies, dosage forms, and formulation processes..	-	
CO2	Explain the different dosage forms in pharmaceutical technology	PO1(2)	PSO2(1)
CO3	Understand the principles of unit operations in pharmaceutical manufacturing.	PO2(2)	PSO1(2)
CO4	Apply knowledge of preformulation and drug development stages.	PO3(2)	PSO1(2)
CO5	Demonstrate and Describe quality control and assurance techniques in pharmaceutical production.	PO11(1)	PSO3(2)

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	PSO1
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)

ME25C03	Introduction to Mechanical Engineering	L	T	P	C
		2	1	0	3

Course Objectives:

- To impart the fundamental concepts and principles of various fields such as Manufacturing, Materials, Mechanics, thermal engineering in Mechanical Engineering.

Engineering: History and evolution of mechanical engineering, Basic mechanical engineering principles (force, motion, energy, work, power), Units and dimensions, SI system, Ethics and professionalism in engineering.

Activities: Interactive quiz, Conversion between SI and other unit systems.

Mechanics of Materials and Structures: Stress and strain, types of stresses (tensile, compressive, shear), Elasticity and plasticity, Mechanical properties of materials (strength, toughness, hardness), Introduction to bending, torsion, and axial loading, Simple structural analysis and design concepts.

Activities: Demonstration of Simple truss or beam problems solved using software.

Energy Interactions: System, Energy Transfer, Conduction, convection, and radiation, Working principle of Heat Engines, Refrigeration and HVAC systems.

Activities: Demonstration of working model of internal combustion engine & refrigerator, Virtual demonstration of Thermodynamic cycles.

Machine Elements: Gears, bearings, shafts, fasteners, couplings, Selection of machine components, Quality control and safety in mechanical engineering.

Activities: Demonstration of working of Gears, bearings, etc. in a mechanical system.

Manufacturing Processes: Casting, forming, machining & joining processes, CNC and additive manufacturing, overview of smart manufacturing.

Activities: Demonstration of various machining processes, 3D printing of simple parts.

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

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

References:

1. Wickert, J., & Lewis, K. (2016). An Introduction to Mechanical Engineering. Cengage Learning.
2. Rajput, R. K., (2017). Fundamentals of Mechanical Engineering, Laxmi Publications.

E-resources:

1. MIT OpenCourseWare – Mechanical Engineering https://ocw.mit.edu
2. PhET Simulations – University of Colorado Boulder https://phet.colorado.edu
3. LibreTexts Engineering https://eng.libretexts.org

	CO Description	PO	PSO
CO1	Explain core mechanical engineering concepts.	---	---
CO2	Apply basic engineering calculations in mechanical systems.	PO1(3)	PSO1(3) PSO2(2)
CO3	Identify common manufacturing processes for engineering applications.	PO2(2)	PSO3(2)

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

Activity: Online logic gate simulators, Solving GATE questions.

Microcontrollers: Introduction, Architecture, Potential Applications.

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

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

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

References:

1. Del Toro, V. (2022). *Electrical engineering fundamentals*. Pearson Education.
2. Hambley, A. R. (Year). *Electrical engineering: Principles and applications* (Edition if known). Publisher.
   (Note: Please provide the year and edition for complete citation)

3. Mehta, V. K., & Mehta, R. (2006). *Principles of electrical engineering and electronics*. S. Chand Publishing.

E-resources:

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

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

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

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

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

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

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

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

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

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

References

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

(Published by: International Institute of Tamil Studies).

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

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.

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**	**PSO**
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. 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

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

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

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

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

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

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

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

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

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

Activities: Application of the second order PDE using open-source software of 1-D wave, 1-D heat equations, Laplace and Poisson equations and Solving Competitive Examination questions

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

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

References:

1. Erwin Kreyszig, Advanced Engineering Mathematics, (11th ed.), John Wiley & Sons, USA,2025.
2. Joe D. Hoffman, Numerical *Methods for Engineers and Scientists* (3rd ed.). CRC Press (Taylor & Francis Group), 2001.
3. Steven C. Chapra and Raymond P. Canale. *Numerical Methods for Engineers* (8th ed.). McGraw-Hill Education, 2021.
4. William E. Boyce and Richard C. DiPrima. *Elementary Differential Equations and Boundary Value Problems,* (11thed.). John Wiley & Sons, USA,2017.
5. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 45th Edition, 2026.
6. Randall J. LeVeque, Finite Difference Methods for Ordinary and Partial Differential Equations, SIAM,2007.

E-resources:

5. https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010/
6. https://archive.nptel.ac.in/content/syllabus_pdf/111107063.pdf
7. 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)

PY25301	Pharmaceutical Biochemistry	L	T	P	C
		3	0	0	3

Course Objectives:

- To develop a strong foundation in the structure, function, metabolism, and clinical relevance of biomolecules, enabling students to analyze biochemical processes.

Biomolecules and Enzymology: Structure and function of carbohydrates, lipids, proteins, nucleic acids. Vitamins and coenzymes. Enzyme classification, kinetics, inhibition, and regulation. Isoenzymes and diagnostic enzymes.

Activities: GDs, quizzes, MCQs, and visualization activities on biomolecules, enzyme kinetics, enzyme-related rare diseases, and nutraceutical labels to identify vitamins, coenzymes, and their biological and pharmaceutical significance.

Metabolism of Biomolecules: Glycolysis, gluconeogenesis, glycogen metabolism. Citric acid cycle, HMP shunt, polyol pathway. β-oxidation, fatty acid synthesis, ketogenesis. Cholesterol metabolism and lipoprotein transport. General amino acid metabolism, urea cycle. Metabolism of individual amino acids. Purine and pyrimidine metabolism.

Activities: Develop flow charts for major metabolic pathways highlighting key intermediates, enzymes, energy yield, metabolic states, related disorders, pharmaceutical interventions disrupting metabolic cycles, and mechanisms involved in detoxification and clearance of toxic byproducts associated with drug-induced liver and kidney injury.

Protein Transport and Targeting: Protein sorting, Signal sequences, targeting signals and Transport, Protein Folding and Chaperones, Protein misfolding, Targeting of proteins to organelles.

Activities: GD/quiz/MCQs on the role of protein targeting in drug discovery and delivery, Analyze diseases related to protein misfolding and discuss underlying mechanisms.

Protein Degradation and Receptor-Mediated Endocytosis: Ubiquitin–proteasome pathway, Lysosomal degradation of proteins, Autophagy, Regulation of protein turnover in cells, Mechanism and stages of endocytosis, Role of receptors, Formation of endosomes and lysosomes, Significance in nutrient uptake and drug delivery.

Activities: Prepare flowcharts comparing ubiquitin–proteasome and lysosomal degradation pathways, conduct GDs/quizzes on receptor-mediated endocytosis, and encourage students to identify and discuss various antibody–drug conjugates (ADCs) and their therapeutic applications.

Applied Biochemistry and Clinical Applications: Biochemical basis of diseases: diabetes, atherosclerosis, jaundice, gout. Free radicals and antioxidants. Biochemical techniques: electrophoresis, chromatography, ELISA. Hormones: biochemical classification, mechanism of action.

Activities: GD/quiz and case studies of metabolic disorders and identify biochemical markers, evaluate the role of free radicals and antioxidants in disease prevention.

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. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2013). Textbook of biochemistry for medical students (7th ed.). Jaypee Brothers Medical Publishers.
2. Chatterjee, M. N., & Shinde, R. (2012). Textbook of medical biochemistry (8th ed.). Jaypee Brothers Medical Publishers.
3. Baynes, J. W., & Dominiczak, M. H. (2019). Medical biochemistry (5th ed.). Elsevier.
4. Satyanarayana, U., & Chakrapani, U. (2017). Biochemistry (5th ed.). Elsevier India.
5. Lehninger Principles of Biochemistry. Nelson, D. L., & Cox, M. M. (2021). *Lehninger principles of biochemistry* (8th ed.). W.H. Freeman and Company.
6. Biochemistry. Berg, J. M., Tymoczko, J. L., Gatto, G. J., Jr., & Stryer, L. (2019). *Biochemistry* (9th ed.). W.H. Freeman and Company.

E-Resources:

1. https://www.ncbi.nlm.nih.gov/books/NBK21154/
2. https://www.khanacademy.org/science/biology/chemistry--of-life
3. https://ocw.mit.edu/courses/7-05-introductory-biochemistry-spring-2021/
4. https://open.umn.edu/opentextbooks/textbooks/866

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the structure, function, and interactions of biomolecules and the mechanisms of enzyme action.	-	-
CO2	Apply biochemical principles to explain metabolic pathways and their regulation under different physiological conditions.	PO1(3), PO2(3)	PSO1(3), PSO2(2)
CO3	Analyze protein sorting, signal sequences, transport, folding, and misfolding mechanisms in normal and disease conditions.	PO2(3), PO4(2)	PSO1(3), PSO2(2)
CO4	Evaluate protein degradation pathways, receptor-mediated endocytosis, and their significance in cellular regulation and drug delivery systems.	PO3(3), PO4(2), PO5(2)	PSO2(2), PSO3(2)
CO5	Evaluate biochemical alterations associated with diseases and correlate them with diagnostic and therapeutic approaches.	PO3(3), PO6(2), PO7(2)	PSO1(3), PSO2(1)
CO6	Demonstrate proficiency in biochemical techniques such as electrophoresis, chromatography, ELISA, and PCR, and interpret their pharmaceutical applications.	PO5(3), PO12(2)	PSO1(3), PSO2(2), PSO3(2)

PY25302	Human Anatomy and Physiology	L	T	P	C
		3	0	0	3

Course Objectives:

- To provide foundational knowledge on the structure and functions of the human body with emphasis on anatomical organization, organ systems, physiological mechanisms, and homeostatic regulation essential for pharmaceutical sciences and healthcare applications.

Introduction to Human Anatomy and Physiology: Definition and scope of anatomy and physiology; Levels of structural organization; Anatomical positions, directional terms, planes, and body cavities; Homeostasis and feedback mechanisms.

Activities: Group discussions, quizzes, MCQs, assignments, diagram-based identification activities, and visual learning exercises on anatomical positions, planes, body cavities, homeostasis, and feedback mechanisms.

Musculoskeletal and Integumentary Systems: Bones and joints – types, structure, and functions; Overview of the muscular Musculoskeletal and Integumentary Systems: system – types and mechanisms of contraction; Integumentary system – skin layers and functions.

Activities: Group discussions, quizzes, MCQs, assignments, chart/model-based classification activities, and visual learning exercises on bones, joints, muscles, muscle contraction, skin structure, and functions.

Nervous, Endocrine, Cardiovascular and Immune Systems: Central and peripheral nervous systems; Synaptic transmission and reflex arcs; Major endocrine glands, hormones, and regulation. Heart anatomy, circulation pathways; Blood components, types, and hemostasis; Lymphatic system and immune overview;

Activities: Group discussions, quizzes, MCQs, assignments, diagram-based activities, and visual learning exercises on nervous transmission, reflex arcs, endocrine regulation, circulation, blood components, immunity, and hemostasis.

Respiratory, Digestive, Excretory and Reproductive Systems: Structure and function of respiratory organs, gas exchange. Anatomy and physiology of alimentary canal; Urine formation, osmoregulation; Male and female reproductive systems; Menstrual cycle and hormonal regulation.

Activities: Group discussions, quizzes, MCQs, assignments, system mapping activities, and visual learning exercises on respiration, digestion, urine formation, osmoregulation, reproductive systems, and hormonal regulation.

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

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

References

1. Marieb, E. N., & Keller, S. M. (2022). *Essentials of human anatomy & physiology* (13th ed.). Pearson Education.
2. Martini, F. H., Nath, J. L., & Bartholomew, E. F. (2021). *Fundamentals of anatomy & physiology* (11th ed.). Pearson.
3. Longenbaker, S. (2011). *Mader's understanding human anatomy & physiology* (7th ed.). McGraw-Hill Education.
4. Waugh, A., & Grant, A. (2018). *Ross & Wilson anatomy and physiology in health and illness* (13th ed.). Elsevier.
5. Hall, J. E. (2020). Guyton and Hall Textbook of Medical Physiology (14th ed.). Elsevier.
6. Saladin, K. S. (2021). *Anatomy & physiology: The unity of form and function* (9th ed.). McGraw-Hill Education.
7. Moore, K. L., Dalley, A. F., & Agur, A. M. R. (2018). *Clinically oriented anatomy* (8th ed.). Wolters Kluwer.
8. Tortora, G. J., & Derrickson, B. H. (2017). *Principles of anatomy and physiology* (15th ed.). John iley & Sons.

E - Resources

1. https://archive.ncarb.org/files/Resources/Documents/Essentials%20Of%20Human%20Anatomy%20And%20Physiology%20Elaine%20Marieb.pdf
2. https://en.pdfdrive.to/dl/essentials-of-human-anatomy-physiology-13th-edition
3. https://e-library.sammu.uz/en/book/1292
4. https://medicalstudyzone.org/essentials-of-human-anatomy-and-physiology-pdf/
5. https://openlibrary.org/subjects/anatomy__physiology
6. https://freeonlinetextbooks.net/marieb-anatomy-and-physiology/

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand anatomical terminology, levels of body organization, and homeostatic mechanisms of the human body.	PO1(3)	PSO1(3)
CO2	Apply the principles of anatomy and physiology to explain the structure and functions of the musculoskeletal and integumentary systems.	PO1(3), PO2(2)	PSO1(3), PSO2(2)
CO3	Analyze the coordination of nervous, endocrine, cardiovascular, and immune systems in maintaining physiological functions.	PO2(3), PO3(2), PO4(2)	PSO1(3), PSO2(3)
CO4	Evaluate the physiological mechanisms involved in respiration, digestion, excretion, and reproduction under normal and altered conditions.	PO3(3), PO4(3), PO5(2)	PSO2(3), PSO3(2)
CO5	Integrate knowledge of human organ systems to interpret physiological balance and predict the consequences of system dysfunctions in health and disease.	PO4(3), PO5(3), PO11(2)	PSO1(3), PSO2(2), PSO3(2)

PY25303	Pharmaceutical Chemistry	L	T	P	C
		3	0	2	4

Course Objectives:

- To inculcate understanding of the properties and principles of medicinal agents that originates from organic and inorganic sources and their application in pharmaceutical industry. To provide the basic functional group identification, molecular rearrangement, chemical bonding with their reaction mechanism. To provide the fundamental principles involved in the identification, preparation of pharmaceutical aids and to apply the principle of coordination compounds in pharmaceutical substances.

Chemical bonding and stereochemistry: Atomic orbitals, molecular orbitals theory, hybrid orbitals, covalent bond, polarity of bonds and molecules, dipole moment, inductive, mesomeric and electromeric effects, intramolecular and intermolecular hydrogen bonding, Isomers, optical activity, stereoisomerism, specification of configuration, chirality.

Activities: Group discussions, quizzes, MCQs, assignments, model-based activities, and visual learning exercises on chemical bonding, hybridization, polarity, isomerism, chirality, stereochemistry, and optical activity.

Organic chemistry: Halides, Aromatic Compounds and Heterocycle
Characteristics of organic compounds, structure, nomenclature, preparation and reaction mechanism of alkyl and aryl halides, Nucleophilic aliphatic substitution reaction, Elimination reactions, electrophilic addition reactions, Huckel's rule, synthesis, properties and chemical reactions of benzenoid and nonbenzenoid compounds, Electrophilic aromatic substitution reaction, General principles of heterocyclic synthesis – Methods of preparation and reactions of Pyridines – Pyrroles – Thiophenes – Furans – Quinolines – Isoquinolines.

Activities: Group discussions, quizzes, MCQs, assignments, case studies, reaction mechanism analysis, and visual learning activities on organic reactions, aromaticity, heterocyclic compounds, synthesis, properties, and electrophilic substitution reactions.

Pharmaceutical inorganic Chemistry: Impurities and Limit tests
Identification and characterization of impurities in pharmaceutical substances, Limit tests: Definition, importance, general procedure for limit test for chlorides, sulphates, iron, arsenic, heavy metals and lead with suitable examples. Identification test for Magnesium sulphate, Ferrous sulphate, Calcium carbonate, Copper sulphate.

Activities: Group discussions, quizzes, MCQs, assignments, case-based learning, and visual activities on pharmaceutical impurities, limit tests, identification tests, heavy metal contamination, and significance of purity standards in pharmaceuticals.

Test for purity: Swelling power of Bentonite, Neutralizing capacity of aluminum hydroxide gel, Determination of potassium iodate and iodine in potassium Iodide Preparation of inorganic pharmaceuticals: Boric acid, Potash alum and Ferrous sulphate. Nitrosoamines impurities.

Activities: Group discussions, quizzes, MCQs, assignments, interpretation-based exercises, and visual learning activities on purity testing, pharmaceutical standards, preparation of inorganic compounds, impurity control, and nitrosoamine contamination.

Preparation of Organic Pharmaceuticals: Formylation reactions, Gattermann Reaction, Gattermann-Koch reaction, Vilsmeier reaction, Meerwein-Ponndorf Verley, Birch reduction, Clemmenson, Sandmeyer, Haloform reactions, Azo coupling, Pechmann reaction, Benzidine rearrangement.

Activities: Group discussions, quizzes, MCQs, assignments, reaction pathway analysis, and visual learning activities on name reactions, reagents, reaction mechanisms, and prediction of reaction products in organic pharmaceutical synthesis.

List of Experiments

Module I - Chemical Bonding and Stereochemistry

1. Model construction and visualization of hybrid orbitals and molecular geometry.
2. Identification and interpretation of optical isomers and stereochemical configurations.
3. Study of intermolecular and intramolecular hydrogen bonding using molecular models.
4. Demonstration of chirality and optical activity using standard compounds/models.

Module II - Organic Chemistry: Halides, Aromatic Compounds and Heterocycles

1. Synthesis of compounds by hydrolysis reaction: Preparation of Salicylic acid from alkyl benzoate.
2. Synthesis of compounds by oxidation reaction: Preparation of Benzoic acid from benzyl chloride.
3. Electrophilic substitution reactions: Benzoylation – Preparation of Benzanilide, Phenyl benzoate, 2-Naphthyl benzoate.
4. Acetylation reaction: Preparation of Aspirin.
5. Nitration reactions: Preparation of Picric acid, p-Nitroaniline, m-Dinitrobenzene.
6. Halogenation reaction: Preparation of p-Bromoacetanilide.

Module III - Pharmaceutical Inorganic Chemistry: Impurities and Limit Tests

1. Identification tests for pharmaceutical inorganic compounds: Magnesium sulphate, Ferrous sulphate, Calcium carbonate, Copper sulphate.
2. Limit tests for impurities in pharmaceutical substances: Chlorides, sulphates, iron, arsenic, heavy metals and lead.
3. Determination of potassium iodate and iodine in potassium iodide.

Module IV - Test for Purity and Preparation of Inorganic Pharmaceuticals

1. Determination of swelling power of Bentonite.
2. Determination of neutralizing capacity of aluminium hydroxide gel.
3. Preparation of inorganic pharmaceuticals: Preparation of Boric acid, Potash alum and Ferrous sulphate.
4. Demonstration and discussion on nitrosoamine impurities and impurity control measures.

Module V - Preparation of Organic Pharmaceuticals and Name Reactions

1. Haloform reaction: Iodoform synthesis.
2. Pechmann reaction: Synthesis of 7-Hydroxy-4-methyl coumarin.
3. Diazotization and azo coupling reaction: Synthesis of 1-Phenyl azo-2-naphthol.

4. Demonstration and interpretation of pharmaceutical name reactions: Gattermann, Gattermann–Koch, Vilsmeier, Sandmeyer, Birch reduction, Clemmensen reduction, Meerwein–Ponndorf–Verley reaction, Benzidine rearrangement.

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. V.Algarsamy, Pharmaceutical Organic Chemistry, Kindle edition, 2020.
2. V.N.Rajasekaran, Textbook of Pharmaceutical Inorganic Chemistry Theory and Practical, CBS Publishers, 2019
3. R.K. Sharma, Text Book of Coordination Chemistry, 1st Edition, Discovery Publishing House Pvt. Ltd.2011.
4. Jr. Leroy G. Wade, Jan William Simek, Maya Shankar Singh, Organic Chemistry, 9 Edition, Pearson Publisher, 2019
5. L.M. Atherden, Bentley and Driver's Textbook of Pharmaceutical Chemistry, 8th Edition, Oxford Publisher, 2020
6. P. L. Soni, Vandna Soni, The Chemistry of Coordination Complexes and Transition Metals, 1st Edition, CRC Press, 2021.
7. Jie Jack Li, Name Reactions A Collection of Detailed Mechanisms and Synthetic Applications, 6th Edition, Springer Publisher, 2021.
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E-Resources:

1. https://www.amazon.in/Pharmaceutical-Organic-Chemistry-V-Alagarsamy-ebook/dp/B08BZX2L2N
2. https://www.cbsindia.org/book/textbook-of-pharmaceutical-inorganic-chemistry
3. https://www.researchgate.net/publication/Coordination_Chemistry_Textbook_RK_Sharma
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6. https://www.routledge.com/The-Chemistry-of-Coordination-Complexes-and-Transition-Metals/Soni-Soni/p/book/9780367486822
7. https://link.springer.com/book/10.1007/978-3-030-50869-3
8. https://www.schandpublishing.com/books/higher-education/chemistry/textbook-organic-chemistry

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the fundamental concepts of molecular structure, bonding, hybridization, resonance, electronic effects, and hydrogen bonding.	-	-
CO2	Apply nomenclature rules and reaction principles to classify and explain the preparation and properties of aliphatic, aromatic, and heteroaromatic compounds.	PO1(3), PO2(3)	PSO1(3), PSO2(2)
CO3	Analyze the mechanisms of electrophilic and nucleophilic substitution reactions and the reactivity of important heterocyclic compounds.	PO2(3), PO3(2), PO4(2)	PSO1(3), PSO2(3)
CO4	Evaluate pharmaceutical substances for impurities using standard limit tests and interpret their significance in quality control and regulatory compliance.	PO4(2), PO5(2), PO6(3)	PSO2(3), PSO3(2)
CO5	Analyze and compare the mechanisms, selectivity, and synthetic applications of important organic reactions and molecular rearrangements.	PO2(3), PO3(3), PO6(2)	PSO1(3), PSO2(3)
CO6	Integrate the knowledge of pharmaceutical aids and coordination compounds to explain their applications in drug formulation, stabilization, and metal-ion chelation.	PO3(2), PO4(2), PO6(2), PO11(1)	PSO1(3), PSO2(3), PSO3(2)

PY25304	Physical Pharmaceutics	L	T	P	C
		3	0	2	4

Course Objectives:

- To impart practice and knowledge on fundamental principles and concepts involved in pharmaceutical powders, liquid flow and dispersions. To provide the knowledge and ability to perform drug stability.

Micromeritics and Powder Rheology

Particle size and distribution, particle number, methods for determining particle size, volume, optical microscopy, sieving, sedimentation, Dynamic light scattering (DLS) technique, measurement of particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders; porosity, packing arrangement, densities, bulkiness, and flow properties. Powder Handling Techniques.

Activities: Group discussions, quizzes, MCQs, assignments, data interpretation, and visual learning activities on particle size analysis, powder flow properties, porosity, densities, and powder handling techniques.

Surface and Interfacial Phenomenon

Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tensions, free energy, spreading coefficient, adsorption at liquid interfaces, surface active agents, HLB classification, solubilization, detergency, adsorption at solid interface, solid gas and solid-liquid interface, complex films, electrical properties of interface.

Activities: Group discussions, quizzes, MCQs, assignments, interpretation-based exercises, and visual learning activities on surface tension, surfactants, adsorption, HLB classification, and pharmaceutical applications of interfacial phenomena.

Viscosity and Rheology

Newtonian system, Law of flow, kinematic viscosity, effect of temperature on viscosity, non-Newtonian systems, plastic, pseudoplastic, dilatant, thixotropy, thixotropy in formulation, determination of viscosity: capillary, falling ball, rotational viscometers.

Activities: Group discussions, quizzes, MCQs, assignments, interpretation-based exercises, and visual learning activities on surface tension, surfactants, adsorption, HLB classification, and pharmaceutical applications of interfacial phenomena.

Dispersion Systems

Colloidal dispersions: Definition, types, properties of colloids, protective colloids, applications of colloids in pharmacy.

Activities: Group discussions, quizzes, MCQs, assignments, comparison-based activities, and visual learning exercises on colloids, suspensions, emulsions, sedimentation, flocculation, stability, and pharmaceutical applications.

Suspensions and Emulsions

Interfacial properties of suspended particles, settling in suspension, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicle, rheological considerations, emulsions; types, theories, Physical stability. Influence of temperature, light, catalytic species, solvent and other factors, Stabilization of drugs, Accelerated stability study, expiration dating.

Activities: Group discussions, quizzes, MCQs, assignments, case-based analysis, stability data interpretation, and visual learning activities on suspensions, emulsions, drug stability, accelerated stability studies, shelf-life, and expiration dating.

Practical Exercises:

Module I - Micromeritics and Powder Rheology

1. Determination of particle size and particle size distribution using various methods of particle size analysis.
2. Determination of surface area of powders.
3. Determination of derived properties of powders such as density, porosity, compressibility, and angle of repose.
4. Determination of effect of glidant on angle of repose of powder.
5. Comparative evaluation of powder flow properties and pharmaceutical processing behavior.

Module II - Surface and Interfacial Phenomenon

1. Determination of surface/interfacial tension.
2. Determination of critical micellar concentration (CMC) of surfactants.
3. Determination of hydrophilic–lipophilic balance (HLB) value of surfactants.

Module III - Viscosity and Rheology

1. Study of rheological properties of various types of systems using different viscometers.
2. Evaluation of rheological behavior of pharmaceutical dispersions.

Module IV - Dispersion Systems

1. Preparation of various types of suspensions and determination of their sedimentation parameters.
2. Formulation and stability assessment of suspensions.

Module V - Suspensions and Emulsions

1. Preparation and stability studies of emulsions.
2. Determination of shelf life of a product based on Arrhenius principle and influence of humidity through Modified Arrhenius equation.
3. Study of surfactants and their applications in pharmaceutical formulations.

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. Manavalan, R. and Ramasamy. C. “Physical Pharmaceutics” January 1, 2017 by Pharma Med Press, 2017.
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3. Hadkar.U.B., Physical Pharmacy, Nirali Prakashan;12th edition,2017.
4. Alfred N. Martin, Patrick J. Sinko, Martin’s Physical Pharmacy and Pharmaceutical Sciences: Physical Chemical and Biopharmaceutical Principles in the Pharmaceutical Sciences, sixth edition, Lippincott Williams & Wilkins, 2011.
5. Remington: The science and practice of pharmacy, 23rd Edition, edited by Adeboye Adejare, Published by Elsevier Inc., 2020
6. Humphrey Moynihan and Abinacrean “Physicochemical Basis of Pharmaceuticals” Oxford University Press, 2009.
7. C.V.S Subrahmanyam & J.Thimma Setty, Laboratory Manual of Physical Pharmaceutics, 2nd Ed., Vallabh Prakashan, 2014.
8. Dr. U. B. Hadkar, Practical Physical Pharmacy & Physical Pharmaceutics, Nirali Prakashan, Pune, 1st edition, 2014.

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2. https://www.vallabhprakashan.com/books/textbook-of-physical-pharmaceutics
3. https://www.niraliprakashan.com/product/physical-pharmacy
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5. https://www.elsevier.com/books/remington-the-science-and-practice-of-pharmacy/adejare/978-0-12-820007-0
6. https://global.oup.com/academic/product/physicochemical-basis-of-pharmaceuticals-9780199235293
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CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles of particle size, surface area, and derived powder properties relevant to pharmaceutical systems.	-	-
CO2	Apply concepts of surface and interfacial phenomena to determine surface tension, critical micelle concentration (CMC), and HLB values of surfactants.	PO1(3), PO2(3)	PSO1(3), PSO2(3)
CO3	Analyze the flow behavior of Newtonian and non-Newtonian systems and evaluate viscosity characteristics of pharmaceutical liquids.	PO2(3), PO3(2), PO4(2)	PSO1(3), PSO2(2)
CO4	Evaluate the properties, stability, and pharmaceutical applications of colloidal systems, suspensions, and emulsions.	PO3(3), PO4(3), PO5(2)	PSO1(3), PSO2(3), PSO3(2)
CO5	Evaluate the stability of pharmaceutical products using accelerated stability testing and interpret stability data.	PO4(3), PO5(3), PO7(2)	PSO2(3), PSO3(2)
CO6	Design pharmaceutical dosage forms by applying the principles of powders, liquids, colloidal systems, and coarse dispersions.	PO3(3), PO5(3), PO11(2)	PSO1(3), 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

	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)

PY25305	Biochemistry and Physiology Laboratory	L	T	P	C
		0	0	4	2

Course objectives:

- To equip students with practical skills in analysing biochemical constituents and physiological parameters, and interpreting results for health assessment and pharmaceutical relevance through hands-on laboratory techniques.

List of Experiments:

Section A – Biochemistry

1. Qualitative tests for carbohydrates
2. Qualitative tests for proteins and amino acids
3. Estimation of blood glucose (GOD-POD method)
4. Estimation of serum proteins (total protein and albumin)
5. Estimation of serum cholesterol and triglycerides
6. Preparation and pH measurement of buffers
7. Paper chromatography/TLC for amino acid separation
8. Enzyme activity assay (e.g., Salivary amylase on starch)
9. Enzyme Isolation / Enzyme Encapsulation

Section B – Physiology

1. Measurement of blood pressure using sphygmomanometer
2. Recording of pulse rate and respiratory rate
3. Blood smear examination – RBC, WBC morphology, Total and Differential Count
4. Determination of hemoglobin content (Sahli's method)
5. Estimation of bleeding time and clotting time
6. Blood group determination
8. Preparation of physiological solution: Ringers' solution, Normal saline

References:

1. Vasudevan, D. M., Sreekumari, S., & Vaidyanathan, K. (2013). Textbook of biochemistry for medical students (7th ed.). Jaypee Brothers Medical Publishers.
2. Hall, J. E. (2020). Guyton and Hall textbook of medical physiology (14th ed.). Elsevier.
3. Ghai, C. L. (2012). A textbook of practical physiology (8th ed.). Jaypee Brothers Medical Publishers.
4. Rajagopal, A., & Ramakrishnan, S. (2013). Practical biochemistry (2nd ed.). Orient Blackswan.
5. Devlin, T. M. (2010). Textbook of biochemistry with clinical correlations (7th ed.). Wiley.
6. Tortora, G. J., & Derrickson, B. H. (2017). Principles of anatomy and physiology (15th ed.). Wiley.
7. Sawhney, S. K., & Singh, R. (2005). Introductory practical biochemistry. Narosa Publishing House.
8. Goyal, R. K. (2010). Practical physiology. CBS Publishers & Distributors.

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1. https://www.jaypeedigital.com/book/9789351523742
2. https://www.elsevier.com/books/guyton-and-hall-textbook-of-medical-physiology/hall/978-0-323-59712-8
3. https://www.jaypeedigital.com/book/9789350902654
4. https://www.orientblackswan.com/details?id=9788125047005
5. https://www.wiley.com/en-in/Textbook+of+Biochemistry+with+Clinical+Correlations%2C+7th+Edition-p-9780470281734
6. https://www.wiley.com/en-in/Principles+of+Anatomy+and+Physiology%2C+15th+Edition-p-9781119329398
7. https://www.narosa.com/bookdetails.asp?isbn=9788173195204
8. https://www.cbsindia.com/book/practical-physiology

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles and procedures involved in basic biochemical identification and estimation techniques.	-	-
CO2	Apply clinical and laboratory methods to assess common physiological parameters and biochemical constituents.	PO2(3), PO5(3)	PSO1(3), PSO2(1), PSO3(2)
CO3	Analyze experimental data and correlate biochemical and physiological variations with normal and pathological conditions.	PO2(3), PO4(2), PO10(2)	PSO1(3), PSO3(2)
CO4	Apply laboratory techniques in diagnostic investigations and pharmaceutical applications.	PO3(3), PO5(3), PO12(2)	PSO1(3), PSO2(1), PSO3(2)
CO5	Demonstrate safe, accurate, and ethical laboratory practices while handling biological samples and analytical instruments.	PO6(2), PO8(2), PO12(2)	PSO2(1), PSO3(2)
CO6	Evaluate blood, urine, and blood-grouping test results and interpret their significance in physiological and pathological conditions.	PO4(3), PO5(2), PO10(2)	PSO1(3), PSO3(2)

Semester IV

PY25401	Pharmaceutical Microbiology	L	T	P	C
		3	0	2	4

Course Objectives:

- To facilitate the students to acquire knowledge about the morphology, growth and control of microorganisms; its industrial and environmental applications.

Fundamentals of Microbiology and Microbial Techniques: The Scope and History of Microbiology; Characterization, Classification, and Identification of Microorganisms; Microscopic Examination of Microorganisms - Light and Electron Microscopy; Different Staining Techniques.

Activities: Conduct group discussions, quizzes, MCQs, assignments, microscopy and staining interpretation, and visual learning activities on microbial classification, morphology, microscopy, staining techniques, environmental monitoring, microbial cell wall differences, and bioburden testing in the pharmaceutical industry.

Structural Biology and Reproductive Mechanisms of Microorganisms: Ultrastructure of bacterial cells and Bacterial multiplication, Viral structure - enveloped and non-enveloped viruses and replication, Fungal structure and reproduction, Algal structure and reproduction, Unique structural features of special microorganisms- Actinomycetes (filamentous bacteria), Mycoplasma, and Bacteriophages.

Activities: Group discussions, quizzes, MCQs, assignments, slide/diagram interpretation, and visual learning activities on microbial structure, reproduction, viral replication, bacteriophage life cycles, and industrial or clinical applications of microorganisms.

Bacterial Nutrition, Growth, and Metabolism: Nutritional Requirements of Bacteria; Bacteriological Media; Growth Curve and Quantitative Measurement of Bacterial Growth; Bacterial Metabolism - Aerobic, Anaerobic Bioenergetics and Utilization of Energy in Biosynthesis of Important Molecules.

Activities: Group discussions, quizzes, MCQs, assignments, growth curve interpretation, case-based discussions, and visual learning activities on bacterial nutrition, metabolism, microbial growth, and antibiotic resistance.

Control of Microorganisms and Medical Microbiology: Physical and Chemical Control of Microorganisms; Chemotherapeutic Agents - Anti-bacterial, Anti-fungal and Anti-viral; Mode of Action and Resistance to Antibiotics; Host-Microbe Interactions; Clinically Important Microorganisms.

Activities: Group discussions, quizzes, MCQs, assignments, case-based discussions, and visual learning activities on microbial control methods, sterilization, antimicrobial agents, host–microbe interactions, clinically important microorganisms, and disease prevention.

Industrial and Environmental Microbiology: Primary Metabolites, Secondary Metabolites and Applications; Preservation of Food; Production of Penicillin, Alcohol and Vitamin B-12; Biogas. Bioremediation and Bioleaching; Biofertilizers and Biopesticides; Microorganisms in Pollution Control; Biosensors.

Activities: Group discussions, quizzes, MCQs, assignments, process flow analysis, and visual learning activities on industrial microbial products, bioremediation, biofertilizers, biosensors, pollution control, clean rooms, and biosafety practices.

List of Experiments

Module I - Fundamentals of Microbiology and Microbial Techniques

1. Microscopic Examination of Bacteria (e.g., Gram staining, simple staining)
2. Acid-Fast and Spore Staining (To identify acid-fast bacteria and spore formers)
3. Preparation and Observation of Yeast and Fungi *(Lactophenol cotton blue staining for fungal structures)*

Module II - Structural Biology and Reproductive Mechanisms of Microorganisms

1. Bacterial Identification using Biochemical Tests (IMViC tests, catalase, oxidase)
2. Demonstration of Mycotoxin-Producing Fungi (e.g., *Aspergillus flavus* under microscope)
3. Preparation and Observation of Yeast and Fungi *(Observation of fungal morphology and reproductive structures)*

Module III - Bacterial Nutrition, Growth, and Metabolism

1. Preparation and Sterilization of Culture Media (Nutrient agar, broth, selective and differential media)
2. Isolation and Enumeration of Microbes (Spread plate, pour plate, and serial dilution methods)
3. Growth Curve Plotting of Bacteria (Turbidimetric and plate count methods)

Module IV - Control of Microorganisms and Medical Microbiology

1. Effectiveness of Disinfectants (Phenol coefficient method or zone of inhibition)
2. Antibiotic Sensitivity Testing (Kirby-Bauer disc diffusion method)
3. Bacterial Identification using Biochemical Tests *(Identification of clinically important bacteria)*
4. Aseptic Transfer Techniques *(Sterile handling and contamination control)*

Module V - Industrial and Environmental Microbiology

1. Fermentation Demonstration *(Production of ethanol or curd using microbes)*
2. Demonstration of Biogas Production (Using cow dung slurry in anaerobic setup)
3. Demonstration of Biofertilizers (Microscopic and cultural characteristics of *Rhizobium*, *Azospirillum*, etc.)

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. Micheal J. Pelczar Jr., E.C.S. Chain and Noel R. Krieg, "Microbiology", 6th Edition, MedTech Science Press, 2024.
2. Jacquelyn G Black and Laura J Black, "Microbiology: Principle and Explorations, 10th Edition, Wiley, 2017.
3. Basanta K Rai, "Essentials of Industrial Microbiology" 4th Edition, Lulu Publishing, USA, 2012.
4. Prescott, Harley, Klein's, "Microbiology", 7th Edition, McGraw Hill, 2022.
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3. https://www.lulu.com/shop/basanta-kumar-rai/essentials-of-industrial-microbiology/paperback/product-1m8n8n7.html
4. https://www.mheducation.com/highered/product/prescott-s-microbiology-willey/M9781260241006.html
5. https://www.mheducation.com/highered/product/foundations-microbiology-talaro/M9780073522549.html

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the classification, morphology, and identification of microorganisms.	-	-
CO2	Explain the growth, nutrition, multiplication, and metabolism of microorganisms.	PO1(3), PO2(2)	PSO1(3), PSO2(2)
CO3	Analyze microbial control methods and resistance mechanisms in different environments.	PO2(3), PO4(2)	PSO1(2), PSO2(3)
CO4	Evaluate the role of microorganisms in industrial, environmental, and pharmaceutical applications.	PO3(3), PO6(2), PO7(2)	PSO2(3), PSO3(2)
CO5	Apply microbiological principles in disease prevention, drug development, industrial production, and pollution control.	PO2(3), PO3(3), PO5(2)	PSO1(2), PSO2(2), PSO3(3)
CO6	Evaluate the significance of microorganisms in human health, biotechnology, and environmental sustainability through case-based analysis.	PO4(3), PO6(3), PO11(2)	PSO2(2), PSO3(3)

PY25402	Cell and Molecular Biology	L	T	P	C
		3	0	0	3

Course Objectives:

- To familiarize the students with the basic cellular processes at molecular level and to integrate the basic concepts and modern applications of molecular biology techniques for disease diagnosis and therapy.

Cell structure, Organisation and Function: Prokaryotic, Eukaryotic cells, Sub-cellular organelles, membrane organisation and transport across membranes, Extra cellular matrix; cytoskeleton- structure and functions; Cell-cell adhesion and junctions; Cell division – mitosis; Cell cycle, Cell signalling mechanisms.

Activities: Group discussions, quizzes, MCQs, assignments, diagram-based activities, and visual learning exercises on cell structure, organelles, membrane transport, cell signalling, cell division, cell types, and targeted drug action.

Molecular Genetics: Introduction to nucleic acids, Structure and functions of DNA, DNA replication – stages of replication, fidelity, replication inhibitors; Telomere replication in eukaryotes; Organisation of prokaryotic and eukaryotic chromosomes; Mutagens, DNA mutations and their mechanism, DNA repair mechanisms. Structure and functions of mRNA, rRNA and tRNA.

Activities: Group discussions, quizzes, MCQs, assignments, model-based activities, case studies, and visual learning exercises on DNA structure, replication, mutations, DNA repair, RNA types, and genetic disorders.

Transcription and Translation: Transcription: Initiation, elongation and termination, Posttranscriptional processing, transcription inhibitors; Elucidation of genetic code, Codon degeneracy, Wobble hypothesis; Steps in translation: Initiation, elongation and termination, Inhibitors of protein synthesis. Posttranslational modifications and its importance.

Activities: Group discussions, quizzes, MCQs, assignments, case-based discussions, and visual learning activities on transcription, translation, genetic code, protein synthesis inhibitors, and posttranslational modifications.

Recombinant DNA Technology: Manipulation of DNA – Restriction and Modification enzymes. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for yeast, insect and mammalian systems, Artificial chromosomes – BACs and YACs, Combinatorial vectors - Cosmid and Phagemid. Production techniques of recombinant proteins - Insulin, Interferons, Erythropoietin; Construction of genomic and cDNA libraries.

Activities: Group discussions, quizzes, MCQs, assignments, case studies, and visual learning activities on recombinant DNA technology, cloning vectors, recombinant proteins, vaccines, and synthetic antibodies.– advantages and disadvantages

Amplification and Sequencing of DNA: Amplification of DNA; Types of PCR – reverse transcription PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Other types of PCR techniques; Site directed mutagenesis; Maxam Gilbert's and Sanger

Coulson's and automated methods of DNA sequencing, Next generation sequencing technologies.

Activities: Group discussions, quizzes, MCQs, assignments, case-based discussions, and visual learning activities on the role of molecular diagnostics in diseases. Discussion on isothermal methods.

Genome analysis and Genomics: Gene therapy; Transgenic technology; Functional genomics; Microarray techniques; Serial Analysis of Gene Expression (SAGE); Regulation of eukaryotic gene expression by small RNAs (RNA interference); Web resources for genomics.

Activities: Group discussion on ethical concerns in gene therapy.

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

Assessment Methodology: Assignments (20%), Seminar on short presentations (20%), Solving of GATE questions (20%), Internal Examinations (40%).

References:

1. Freifelder's Essentials of Molecular Biology, George M. Malacinski, 4th edition, Narosa Publishing House Pvt Ltd., 2008.
2. Lodish, H., Berk, A., Kaiser, C. A., Krieger, M., Bretscher, A., Ploegh, H., Martin, K. C., Yaffe, M., & Amon, A. Molecular cell biology, 9th edition, New York: W.H. Freeman-Macmillan Learning, 2021.
3. James D. Watson, Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, Richard Losick, Molecular Biology of the Gene 7th edition, Cold Spring Harbor, 2013.
4. Alberts, Johnson, Lewis, Morgan, Raff, Roberts and Walter, Molecular Biology of the Cell, 7th Edition, *W.W. Norton*, 2022.
5. Benjamin A. Pierce - Genetics_ A Conceptual Approach. H. Freeman, 6th edition, 2017.

E-Resources:

1. https://www.narosa.com/bookdetails.asp?isbn=9788173199684
2. https://www.macmillanlearning.com/college/us/product/Molecular-Cell-Biology/p/1319208523
3. https://www.cshlpress.com/default.tpl?cart=174&id=880
4. https://wwnorton.com/books/9780393884821
5. https://www.macmillanlearning.com/college/us/product/Genetics-A-Conceptual-Approach/p/1319050962
6. https://www.ncbi.nlm.nih.gov/books/NBK21054/
7. https://www.youtube.com/playlist?list=PLwdnzlV3ogoW9QiY4FJXeliA6Q_fJkaDS - Molecular Biology by Prof Vishal Trivedi, Bioscience and Bioengineing, IIT Guwahati

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the structure and functions of prokaryotic and eukaryotic cells and their cellular components.	-	-
CO2	Explain the structure and function of nucleic acids and the significance of the central dogma in living systems.	PO1(3), PO2(2)	PSO1(1), PSO3(1)
CO3	Apply recombinant DNA technology and DNA manipulation techniques for the production of recombinant proteins and other bioproducts.	PO2(3), PO3(3), PO5(2)	PSO1(3), PSO3(3), PSO4(2)
CO4	Analyze the applications of PCR, DNA sequencing, and related molecular techniques in disease diagnosis and genetic analysis.	PO2(3), PO4(3), PO5(2)	PSO4(2)
CO5	Evaluate genomic information and molecular data for disease diagnosis, therapy, and personalized medicine applications.	PO3(3), PO4(3), PO6(2)	PSO3(1), PSO4(2)
CO6	Integrate concepts of cell biology and molecular biology to understand disease mechanisms and develop diagnostic and therapeutic approaches.	PO4(3), PO5(2), PO11(3)	PSO3(2), PSO4(2)

PY25403	Chemical Process Calculation and Fluid Flow Operations	L	T	P	C
		3	0	2	4

Course objectives:

- To learn the basic calculation techniques used in process industries. Learn the laws governing the behaviour of gases, liquids, and solids for analysing and designing chemical processing equipment, using data sources containing relevant physical and chemical properties. Gain fundamental knowledge about the flow properties of different types of fluids and their momentum balance. Understand various fluid transport methods, flow measurement techniques, and fluid machinery.

Mathematical and Engineering Calculations: Units and dimensions, conversion units, expression and equations, Dimensional groups and constants, stochiometric and composition relationships, conversion of mass, mass and volumetric reactions, basis of compositions, Excess reactants, degree of completion. Ideal Gases & vapor Pressure: Behaviour of ideal gases, Gaseous mixtures, vapor pressure, Clausius Clapeyron equation, Cox chart, Duhring's plot, Raoult's law, Humidity and saturation, relative humidity, humid volume, dew point, humidity chart and its use.

Activities: Group discussions, quizzes, MCQs, assignments, problem-solving exercises, and visual learning activities on unit conversions, dimensional analysis, stoichiometry, gas laws, vapor pressure, humidity calculations, and engineering applications.

Material Balance: Crystallization, dissolution, solving material balance problems with and without simultaneous equations, Recycle, bypass and purge calculations Heat of vaporization, Heat of formation, Heat of combustion of fuels, Heat and Theoretical flame temperature. Energy Balance: Heat capacity, calculation of enthalpy changes, Energy balance with chemical reactions.

Activities: Group discussions, quizzes, MCQs, assignments, numerical problem-solving, and visual learning activities on material balance, crystallization, recycle systems, heat calculations, enthalpy changes, and energy balance in chemical processes.

Fluid Mechanics and Classification of Fluids: Properties of fluid, forces on fluid, stresses, the concept of constitution relations, fluid statics, Normal forces in fluid, pressure measurement, forces on submerged bodies, buoyancy, Stability. Classification of Fluids: Newtonian and Non – Newtonian fluid, Viscosity measurement, Equations of changes: Equation of Continuity & Equation of Motion, Navier stokes equation, concept of Reynolds number and friction factor: friction for rough and smooth pipes, loss of head due to friction in pipes and fittings.

Activities: Group discussions, quizzes, MCQs, assignments, flow analysis, and visual learning activities on fluid properties, pressure measurement, Newtonian and non-Newtonian fluids, viscosity, Reynolds number, friction losses, and industrial applications of laminar and turbulent flow.

List of Experiments

Section A: Chemical Process Calculations

1. Stoichiometry and Composition Calculations
2. Material Balance without Chemical Reactions
3. Material Balance with Chemical Reactions
4. Recycle, Bypass, and Purge Calculations
5. Energy Balance in Mixing and Heating
6. Calculation of Theoretical Flame Temperature

Section B: Fluid Flow Operations

7. Verification of Bernoulli's Theorem
8. Viscosity Measurement of Newtonian and Non-Newtonian Fluids
9. Reynolds Number and Flow Regime Determination
10. Friction Losses in Pipes and Fittings
11. Flow Measurement using Venturimeter and Orifice Meter
12. Flow Measurement using Rotameter
13. Study of Centrifugal Pump Characteristics
14. Performance Evaluation of Air Blower/Fan
15. Pitot Tube for Velocity Measurement

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. Himmelblau, D. M. and Riggs, B. J. "Basic Principles and Calculations in Chemical Engineering", 8th Edition, Prentice Hall International series, 2015.
2. Bhatt, B.I. and Thakore, S.M., "Stoichiometry", 5th Edition, Tata McGraw Hill, Education Pvt. Ltd, 2017.
3. McCabe W.L, Smith, J C and Harriot. P "Unit operations in Chemical Engineering", McGrawHill, 7th Edition, 2005
4. Munson, B. R., Young, D.F., Okiishi, T.H. "Fundamentals of Fluid Mechanics", 5th Edition", John Wiley, 2006.

E-Resources:

1. https://www.pearson.com/en-us/subject-catalog/p/basic-principles-and-calculations-in-chemical-engineering/P200000003393/9780133887518
2. https://www.mheducation.co.in/stoichiometry-9780070682109-india
3. https://www.mheducation.com/highered/product/unit-operations-chemical-engineering-mccabe-smith/M9780072848237.html
4. https://www.wiley.com/en-us/Fundamentals+of+Fluid+Mechanics%2C+5th+Edition-p-97804702628498

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the concepts of composition, concentration, and density of mixtures and express them using different engineering units.	-	-
CO2	Apply material balance principles to solve process calculations with and without chemical reactions.	PO1(3), PO2(3)	PSO1(3), PSO2(3)
CO3	Apply energy balance concepts to analyze energy requirements in chemical engineering processes and industrial operations.	PO1(3), PO2(3), PO3(2)	PSO1(2), PSO2(3), PSO3(2)
CO4	Analyze mathematical models associated with fluid-flow systems and interpret their engineering applications.	PO2(3), PO4(3), PO5(3)	PSO2(3), PSO3(3)
CO5	Evaluate fluid flow through porous and packed solids and assess its significance in chemical process industries.	PO3(3), PO4(2), PO5(3), PO6(1)	PSO1(2), PSO2(2), PSO3(3)

PY25404	Pharmaceutical Analysis	L	T	P	C
		3	0	0	3

Course Objectives:

- To facilitate students to acquire knowledge about the principles and applications of pharmaceutical analysis.

Online-Process Analytical Technology: On-line PAT Applications of Spectroscopy in the Pharmaceutical Industry: Reaction Monitoring - Crystallization - API Drying - Nanomilling - Hot-melt Extrusion – Granulation - Wet granulation - Roller compaction - Powder Blending - Lubrication - Powder flow - Compression – Coating - Biologics - Fermentation - Freeze-drying - Cleaning Validation.

Activities: Students analyze real or simulated process data to monitor a pharmaceutical operation (e.g., granulation or drying), identifying critical parameters using PAT tools. GD on different spectroscopy techniques (NIR, IR, Raman) to industrial applications like crystallization, blending, and coating, explaining their role in pharmaceutical R&D.

Modern extraction methods and pharmaceutical property analysis: Strategies of sample preparation – liquid – liquid extraction, solid-liquid extraction – solid phase extraction techniques – radiometric analysis – Analysis of biological compounds – analysis of water. Solubility determination – Molecular weight determination – viscosity determination – Surface tension determination – Particle size analysis – X-ray diffraction – Polarimetery – refractometry.

Activities: Students perform or simulate sample preparation methods (liquid-liquid extraction, solid-phase extraction) and compare efficiency for isolating compounds, A group activity evaluating different analytical techniques (XRD, polarimetry, refractometry, particle size analysis), selecting appropriate methods for specific pharmaceutical samples.

Pharmaceutical purity and quality control tests: Appearance, absorbance, pH, related substances, residual solvents, foreign anions, sulfated ash, elemental impurities, loss on drying, moisture and water, oxidizing substances, acid value, hydroxyl value, iodine value, peroxide value, saponification value, unsaponifiable matter – Functional group analysis.

Activities: Students analyze pharmaceutical samples using parameters like pH, moisture content, and absorbance, interpreting results based on pharmacopeial standards, A group activity calculating physicochemical constants (acid value, iodine value, saponification value) and relating them to drug quality and stability.

Validation and statistical control: Control of errors in analysis – calibration methods - Accuracy and precision – validation of analytical procedures – SOPs – compound random errors – reporting of results – terms used in the control of analytical procedures – calculations in pharmaceutical analysis: percentage, dilutions, preparation of standard stock solutions, parts per million calculations – normality – molarity – molality – analytical standards – fundamentals of statistical analysis in pharmaceutical analysis.

Activities: Students perform calculations for standard solutions (molarity, normality, ppm, dilutions), preparing stock solutions accurately, A group activity identifying sources of analytical errors and applying validation techniques (accuracy, precision, calibration), ensuring reliability of results.

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. Pharmaceutical Analysis P. D. Chaithanya Sudha, Pearson, 2013.
2. Pharmaceutical Drug Analysis, Ashutosh Kar. New Age international Pvt Ltd. 2005.
3. Siddiqui, Anees A. “Pharmaceutical Analysis”. Vol.I & II, CBS,2006
4. A.H. Beckett & J. B. Stenlake, “Practical Pharmaceutical Chemistry”, Part II, 4th Edition, Bloomsbury Academic, 2001.
5. Pharmaceutical Analysis A Textbook for Pharmacy Students and Pharmaceutical Chemists. Third Edition David G. Watson. Churchill Livingstone Elsevier. 2012.
6. Pharmaceutical Analysis for Small Molecules, First Edition. Edited by Behnam Davani. © 2017 John Wiley & Sons, Inc. Published 2017 by John Wiley & Sons, Inc.
7. Mendham J, “Vogel’s Text Book of Quantitative Chemical Analysis”, 6th Edition, Pearson Education 2009.
8. Process Analytical Technology: Spectroscopic Tools and Implementation Strategies for the Chemical and Pharmaceutical Industries, Second Edition Edited by Katherine A. Bakeev © 2010 John Wiley & Sons, Ltd. ISBN: 978-0-470-72207-7.
9. Introduction to Pharmaceutical Analytical Chemistry, Stig Pedersen-Bjergaard, Bente Gammelgaard, Trine Grønhaug Halvorsen, Second Edition 2019, Wiley.

E-Resources:

1. https://www.pearson.com/en-in/subject-catalog/p/pharmaceutical-analysis/P200000005389
2. https://www.newagepublishers.com/servlet/nagetbiblio?bno=001234
3. https://www.cbsindia.com/book/pharmaceutical-analysis-vol-1-2
4. https://www.bloomsbury.com/uk/practical-pharmaceutical-chemistry-9780486420054/
5. https://www.elsevier.com/books/pharmaceutical-analysis/watson/9780702042997
6. https://www.wiley.com/en-us/Pharmaceutical+Analysis+for+Small+Molecules-p-9781119095231
7. https://www.pearson.com/en-in/subject-catalog/p/vogels-textbook-of-quantitative-chemical-analysis/P200000003168
8. https://www.wiley.com/en-us/Process+Analytical+Technology%3A+Spectroscopic+Tools+and+Implementation+Strategies-p-9780470722077
9. https://www.wiley.com/en-us/Introduction+to+Pharmaceutical+Analytical+Chemistry-p-9781119153436

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles of Process Analytical Technology (PAT) and its role in pharmaceutical manufacturing and quality control.	-	-
CO2	Apply appropriate sample preparation techniques for qualitative and quantitative pharmaceutical analysis.	PO2(3), PO5(3)	PSO1(3), PSO2(2)
CO3	Apply physical analytical methods and instrumental techniques for the characterization of pharmaceutical substances and products.	PO2(3), PO5(3)	PSO1(2), PSO2(3)
CO4	Analyze chemical analytical methods and functional group identification for pharmaceutical compounds.	PO3(3), PO4(2)	PSO1(2), PSO2(3), PSO3(2)
CO5	Evaluate analytical method performance through validation, quality assurance, and regulatory compliance requirements.	PO4(3), PO7(3), PO11(2)	PSO2(3), PSO3(3)
CO6	Interpret analytical data and perform pharmaceutical calculations for decision-making in quality assessment and process control.	PO3(3), PO5(2), PO10(2)	PSO1(2), PSO2(2), PSO3(3)

PY25405	Dosage Forms Technology - I	L	T	P	C
		3	0	0	3

Course Objectives:

- To acquire the skills in design, formulation and characterize pharmaceutical dosage forms.

Dosage Form Design Formulation Considerations: Need for Dosage Forms - Preformulation Studies – Bulk Characterization – Solubility and pH – Molecular dissociation - pKa – log P – Dissolution rate – Salt selection – Polymorphism – Stability Analysis – Pharmaceutical Excipients in solid dosage forms.

Activities: Group discussions, quizzes, MCQs, assignments, case-based analysis, and visual learning activities on preformulation studies, physicochemical properties, polymorphism, stability, excipients, and dosage form selection.

Powders and Granules: Advantages and disadvantages of powdered and granulated products, Mixing and dividing of powders, Problems in manufacturing powders, Reasons for granulation, Granulation mechanisms, Granulation methods, pharmaceutical granulation equipment's.

Activities: Group discussions, quizzes, MCQs, assignments, process design exercises, and visual learning activities on powder handling, granulation methods, granulation mechanisms, and pharmaceutical equipment selection.

Tablets and Capsules: Types of tablets, Formulation, Manufacturing of tablets, Tableting problems, Evaluation of Tablets, Tabletting equipments - Machine Tooling. Capsules – Classification, Gelatin and Non-gelatin Capsules – Hard gelatin capsules, Composition and size, Materials and methods for production of hard gelatin capsule, Formulation and filling of capsules, Soft gelatin capsules, Rationale, Manufacturing and formulation of soft gelatin capsules, Evaluation of capsules

Activities: Group discussions, quizzes, MCQs, assignments, formulation-based exercises, and visual learning activities on tablet and capsule formulation, manufacturing, evaluation, defects, and pharmaceutical equipment.

Coating and Encapsulation: Tablet coating, Film coating, Sugar Coating, Enteric coating, Quality Control Tests, Applications, Equipments in Large Scale Manufacture. Microencapsulation in pharmaceutical technology, Microencapsulation by coacervation, Phase separation, Multi-orifice centrifugation, Spray congealing, Polymerization, Air suspension technique, Pan coating and other techniques, Quality control of microcapsules.

Activities: Group discussions, quizzes, MCQs, assignments, comparative analysis, and visual learning activities on coating techniques, drug release behavior, microencapsulation methods, quality control, and large-scale manufacturing applications.

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. Lachman/Lieberman's: The Theory and Practice of Industrial Pharmacy, Editors Vyas S. P, Roop Krishen Khar, 4th Edition, 2020. CBS Publishers & Distributors, New Delhi.
2. A Text book of Industrial Pharmacy – I by B. Prakash Rao, S. Rajarajan, Beny Baby, First Edition, 2019. Nirali Prakashan, Pune. [ISBN 978-93-89533-32-3]
3. Kavitha Karuppaiyan, Nilima Thombre, Hitendra Mahajan, Shilpa Chowdary, Karimunnissa sheikh, Concepts of Industrial Pharmacy–I, First Edition, May, 2022, Pharma Career Publications.
4. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems
5. Handbook of Preformulation Chemical, Biological, and Botanical Drugs Second Edition.

E-resources:

1. https://www.cbsindia.com/book/the-theory-and-practice-of-industrial-pharmacy
2. https://www.niraliprakashan.com/product/industrial-pharmacy-i
3. https://pharmacareerpublications.com/product/concepts-of-industrial-pharmacy-i
4. https://www.wolterskluwer.com/en/solutions/ovid/ansels-pharmaceutical-dosage-forms-and-drug-delivery-systems-1563
5. https://www.taylorfrancis.com/books/mono/10.1201/9781420004342/handbook-preformulation-chemical-biological-botanical-drugs

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand the principles of preformulation studies and their significance in pharmaceutical dosage form development.	-	-
CO2	Explain the properties and processing characteristics of pharmaceutical powders and granules.	PO1(3), PO2(2)	PSO1(3), PSO2(2)
CO3	Apply formulation and characterization techniques for the development of tablets and capsules.	PO2(3), PO3(3), PO5(3)	PSO1(2), PSO2(3), PSO3(2)
CO4	Analyze coating processes and evaluate their impact on dosage form performance and stability.	PO3(3), PO4(2), PO5(2)	PSO2(3), PSO3(2)
CO5	Evaluate microencapsulation techniques for improving drug delivery, stability, and therapeutic effectiveness.	PO4(3), PO5(2), PO6(2)	PSO2(2), PSO3(2)
CO6	Design and characterize pharmaceutical dosage forms by integrating preformulation, formulation, and evaluation principles.	PO3(3), PO5(3), PO11(3)	PSO1(3), PSO2(3), PSO3(3)

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

Course Objectives:

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

List of Activities

Stage Ready – Impactful Public Speaking.

(i) Simulate a formal event such as an academic conference, convocation, or awards ceremony, where students roles including Master of Ceremonies (MC), Role as a dignitary, and a Commentator
(ii) Visual Prompt Storytelling: Use random images to create spontaneous stories, focusing on plot, setting, and character,
(iii) Digital Presentation - Record a short video explaining a project or technical concept, using slides, voiceover, and visual aids (to be uploaded using google classroom or drive link)

Professional and Application-Oriented Writing

(i) Résumé Preparation: Design ATS-friendly résumés tailored to various job descriptions, using action verbs and quantifiable impact. ·
(ii) Design engaging content for poster presentation relevant to their domain.

Receptive Skills in Workplace Communication·

(i) Reading articles related to their domain and discuss in groups
(ii) Visit company websites, make inferences and present in the class
(iii) Listen to recorded mock interviews and take detailed notes. Summaries key points and action items in a professional format and make a presentation.

Intercultural Communication

(i) Assertive vs Aggressive communication
(ii) Role play activities – workplace communication in intercultural/crosscultural contexts

From Campus to Career: Industry Skills and Global Exam Preparation

(i) Participate in HR interviews using AI tools or peer interviewers, responding to behavioural questions using methods like STAR (Situation, Task, Action, Result)
(ii) Practice Verbal Ability in competitive exams like UPSC, SSC, CDS, TNPSC, etc.

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

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

End Semester Assessment:

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

References:

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

E-resources:

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

CO Mapping with PO & PSO:

	Description of CO	PO	PSO1
CO1	Understand basic industry-related reading materials.	-	-
CO2	Design and present a domain specific poster	PO9(3)	PSO1(2) PSO3(3)
CO3	Deliver effective digital presentations	PO9(3)	PSO2(1)
CO4	Communicate appropriately in intercultural/cross cultural contexts	PO9(3)& PO11(1)	PSO3(3)
CO5	Perform in interviews and competitive exams successfully	PO9(3)	PSO3(1)

PY25406	Introduction to Standards in Pharmaceutical Technology	L	T	P	C
		1	0	0	1

Course Objectives:

- To provide hands-on exposure to pharmaceutical industry practices including manufacturing, quality systems, regulatory compliance, R&D, and industrial management.

Strategic Value of Standards - Scientific significance of pharmacopoeial standards in ensuring identity, strength, quality, and purity of medicines. Role of USP public standards in establishing global quality benchmarks. Economic impact of standards in reducing drug development costs, facilitating generic drug entry, and minimizing information asymmetry in pharmaceutical supply chains. Principles of reference standard management, including characterization, stability, storage conditions, and usage of primary and working standards.

Activities

- Case study discussion on pharmacopeial standards in global pharmaceutical trade. (e.g., ethylene glycol tragedy)
- Identification of reference standard labels and certificates.
- Group discussion on economic benefits of standardization in generic drug development.

Global Pharmacopoeias and Monograph Design - Overview of major pharmacopoeias including Indian Pharmacopoeia (IP), British Pharmacopoeia (BP), United States Pharmacopeia (USP), European Pharmacopoeia (EP), Japanese Pharmacopoeia (JP), and the International Pharmacopoeia. Structure and components of pharmacopoeial monographs, including identification tests, impurity profiling (organic, inorganic, residual solvents), and assay methods. Role of the Pharmacopoeial Discussion Group (PDG) in harmonizing global testing standards.

Activities

- Analysis of a sample drug monograph from IP/USP.
- Comparative study of assay methods a single component drug by UV/HPLC.
- Student presentation on global pharmacopoeial harmonization initiatives.

GxP Compliance - Concept of the GxP framework, including Good Manufacturing Practice (GMP), Good Laboratory Practice (GLP), and Good Distribution Practice (GDP). Role of the Pharmaceutical Inspection Co-operation Scheme (PIC/S) in harmonizing global pharmaceutical inspections. Quality system requirements based on WHO Technical Report Series (TRS) guidelines and ICH Q9 quality risk management. Importance of site master files and inspection readiness.

Activities

- Preparation of a Site Master File outline.
- Simulation exercise on pharmaceutical inspection readiness.
- Group discussion on GMP compliance failures and regulatory actions.

Digital Standards and System Validation - Regulatory requirements for digital compliance, including 21 CFR Part 11 and EU GMP Annex 11. Principles of data integrity (ALCOA+). Validation of computerized systems using the GAMP-5 V-model approach. Conduct of quality audits, identification of non-conformances, and implementation of Corrective and Preventive Actions (CAPA).

Activities

- Case analysis of data integrity violations in pharmaceutical companies.
- Demonstration of ALCOA+ principles in laboratory documentation.
- Audit simulation identifying non-conformances and CAPA planning.

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

Assessment Methodology: Continuous Assessment (40%)

- Quiz / MCQ test on pharmacopoeial standards – 10%
- Assignment / case study analysis – 10%
- Activity-based presentation (monograph/GMP audit simulation) – 10%
- Internal test – 10%
- End Semester Examination (60%)

References

1. Sharma, N., et al. *Understanding Pharmaceutical Standards and Regulations.* Routledge, 2025.
2. Nally, J. D., & McConnell, M. *Good Manufacturing Practices for Pharmaceuticals: A Plan for Total Quality Control.* CRC Press.
3. Willig, S. H., Stoker, J. R., & Lyda, R. F. *Good Manufacturing Practices for Pharmaceuticals.* CRC Press / Informa Healthcare.
4. Williams, D. R., et al. (2018). "The Value of U.S. Pharmacopeial Standards: A Review of the Literature." *Journal of Pharmaceutical Sciences*, 107(10).
5. United States Pharmacopeial Convention. *United States Pharmacopeia – National Formulary (USP–NF).* USP Convention, Rockville, USA.
6. Indian Pharmacopoeia Commission. *Indian Pharmacopoeia.* Ministry of Health and Family Welfare, Government of India.
7. Segalstad, S. H. *International IT Regulations and Compliance.* Wiley, 2008.
8. World Health Organization (WHO). *WHO Technical Report Series: Expert Committee on Specifications for Pharmaceutical Preparations.* WHO Press.

E-Resources

1. United States Pharmacopeia (USP): https://www.usp.org
2. Indian Pharmacopoeia Commission: https://ipc.gov.in
3. European Directorate for the Quality of Medicines (EDQM): https://www.edqm.eu
4. ICH Guidelines (Quality): https://www.ich.org
5. WHO Guidelines on Good Manufacturing Practices: https://www.who.int/teams/health-product-policy-and-standards/standards-and-specifications

CO Mapping with PO & PSO:

CO	Description of CO	PO Mapping	PSO Mapping
CO1	Understand pharmaceutical standards and their significance in ensuring drug quality, safety, and regulatory compliance.	-	-
CO2	Analyze pharmacopoeial monographs, reference standards, and regulatory requirements for pharmaceutical products.	PO2 (2), PO4 (2)	PSO1 (3)
CO3	Evaluate GxP practices, quality systems, and digital regulatory frameworks for compliance in pharmaceutical industries.	PO5 (2), PO7 (1)	PSO2 (2), PSO3 (3)

	Industry Internship	L	T	P	C
		0	0	0	2

Course Objectives:
To provide hands-on exposure to pharmaceutical industry practices including manufacturing, quality systems, regulatory compliance, R&D, and industrial management.

Weightage: Continuous Assessment (Industry mentor): 60%, End Semester Examinations: 40%.

Assessment Methodology: Attendance Certificate (Issued by Industry/organization), Internship Report, Logbook / Diary- 60 Marks, End Semester Review Assessment (Presentation / Viva-voce) – 40 Marks

CO-PO Mapping

CO	Description of CO	PO	PSO
CO1	Demonstrate knowledge of pharmaceutical manufacturing processes, unit operations, and Good Manufacturing Practices (GMP) followed in industry.	PO1(3), PO2(2), PO4(1), PO5(2), PO6(1), PO8(1), PO9(1),PO12(2)	PSO1(3), PSO2(1), PSO3(2)
CO2	Apply Quality Control (QC) and Quality Assurance (QA) principles to perform analytical testing, interpret results, and ensure product quality compliance.	PO1(3), PO2(3), PO3(1), PO4(2), PO5(3), PO6(1), PO8(1), PO9(1), PO10(1), PO12(2)	PSO1(3), PSO2(1), PSO3(2)
CO3	Analyze formulation development processes including preformulation studies, excipient compatibility, and scale-up techniques in R&D**.**	PO1(2), PO2(2), PO3(3), PO4(2), PO5(2), PO8(1), PO9(1), PO10(1), PO11(1), PO12(2)	PSO1(3), PSO2(1), PSO3(2)
CO4	Interpret and prepare basic regulatory documentation in accordance with national and international guidelines for drug approval and compliance.	PO1(2), PO2(2), PO3(1), PO4(1), PO5(1), PO6(2), PO8(2), PO9(1), PO10(2), PO11(1), PO12(2)	PSO1(2), PSO2(2), PSO3(3)
CO5	Evaluate industrial safety practices, environmental considerations, and ethical standards in pharmaceutical operations.	PO1(1), PO2(2), PO3(1), PO5(1), PO6(3), PO7 (3), PO8(3), PO9(2), PO10(1), PO11(2), PO12(2)	PSO1(2), PSO2(1), PSO3(2)

CO	Description of CO	PO	PSO
CO6	Demonstrate professional skills including teamwork, communication, documentation, and project management during industrial training.	PO1(1), PO2(1), PO3(1), PO5(1), PO6(1), PO8(2), PO9(3), PO10(3), PO11(3), PO12(2)	PSO1(2), PSO2(3), PSO3(2)