ANNA UNIVERSITY, CHENNAI

UNDERGRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: B.Tech. Food 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:

PSO1: Design and Develop efficient food processes techniques for quality food products.

PSO2: Use software for the effective monitoring and controlling the food safety and also solve complex problems in food industries.

PSO3: Adapt to emerging food technologies and implement eco-friendly practices and regulatory standard.

Semester – I							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C01	Applied Calculus	T	3-1-0	4	4	BS
2.	FD25101	Introduction to Food Technology	T	2-1-0	3	3	PC (DIC)
3.	UC25H01	தமிழர் மரபு / Heritage of Tamils	T	1-0-0	1	1	HUM
4.	EN25C01	English Essentials – I	T	2-0-0	2	2	HUM
5.	PH25C01	Applied Physics – I	LIT	2-0-2	4	3	BS
6.	CY25C01	Applied Chemistry – I	LIT	2-0-2	4	3	BS
7.	CS25C02	Computer Programming: Python	LIT	2-0-2	4	3	ES(PC)
8.	ME25C04	Makerspace	L	0-0-4	4	2	SD
9.	UC25A01	Life Skills for Engineers – I	---	1-0-2	3	1	HUM
10.	UC25A02	Physical Education – I	---	0-0-4	4	1	HUM
11.		NCC / NSS / NSO / YRC	---	---	---	---	---
			Total Credits		**29**	**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.	EE25C01	Basic Electrical and Electronics Engineering	T	3-0-0	3	3	ES (G)
3.	FD25201	Environmental Monitoring in Food Industries	T	3-0-0	3	3	ES (PC)
4.	FD25202	Principles of Thermodynamics	T	3-0-0	3	3	ES (PC)
5.	UC25H02	தமிழர்களும் தொழில்நுட்பமும் Tamils and Technology	T	1-0-0	1	1	HUM
6.	ME25C01	Engineering Drawing	LIT	2-0-4	6	4	ES (G)
7.	PH25C06	Applied Physics (Tech) – II	T	2-1-0	3	3	BS
8.	ME25C05	Re-Engineering for Innovation	L	0-0-4	4	2	SD
9.	EN25C02	English Essentials – II	LIT	1-0-2	3	2	HUM
10.	UC25A03	Life Skills for Engineers – II	---	1-0-2	3	1	HUM
11.	UC25A04	Physical Education – II	---	0-0-4	4	1	HUM
12.		Foreign Language^	LIT	1-0-2	3	1	HUM
Total Credits					**40**	**28**	

^ Deutsch / Japanese / Korean

Semester – III							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C09	Computational Differential Equations	T	3-1-0	4	4	BS
2.	FD25301	Food Microbiology	LIT	3-0-4	7	5	ES (PC)
3.	FD25302	Biochemistry and Human Nutrition	LIT	3-0-4	7	5	ES (PC)
4.	FD25303	Stoichiometry in Food Industries	T	2-1-0	3	3	ES (PC)
5.	FD25304	Fluid Mechanics and Mechanical Operations	LIT	3-0-4	7	5	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
Total Credits					**33**	**25**	

Semester – IV							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.	MA25C13	Probability and Statistics	T	3-1-0	4	4	BS
2.	FD25401	Heat and Mass Transfer in Food Processing	LIT	3-0-4	7	5	ES (PC)
3.	FD25402	Food Chemistry	LIT	3-0-4	7	5	ES (PC)
4.	FD25403	Food Additives and Flavors	T	3-0-0	3	3	ES (PC)
5.	EN25C04	English Communication Skills Laboratory – II	L	0-0-2	2	1	HUM
6.	FD25404	Standards in Food Technology	T	1-0-0	1	1	ES (PC)
7.	-	Skill Development Course – II	LIT	1-0-2	3	2	SD
				Total Credits	**27**	**21**	

Semester – V							
S. No.	**Course Code**	**Course Name**	**Course Type**	**Periods / Week**		**Credits**	**Category**
				L-T- P	**TCP**		
1.		Food Analysis	LIT	3-0-4	7	5	ES (PC)
2.		Food Refrigeration and Cold Chain	T	3-0-0	3	3	ES (PC)
3.		Beverage Technology	T	3-0-0	3	3	ES (PC)
4.		Programme Elective – I	T	3-0-0	3	3	ES (PE)
5.		Programme Elective - II	T	3-0-0	3	3	ES (PE)
6.		Food Process Engineering	T	3-1-0	4	4	ES (PC)
7.		Skill Development Course – III	LIT	1-0-2	3	2	SD
8.		Industry Oriented Course – I	LIT	1-0-2	3	1	SD
				Total Credits	**29**	**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	

Semester – VI							
S. No.	Course Code	Course Name	Course Type	Periods / Week		Credits	Category
				L-T- P	TCP		
1.		Food Business Management and Entrepreneurship	T	3-0-0	3	3	ES (PC)
2.		Total Quality Management	T	3-0-0	3	3	ES (PC)
3.		Post-Harvest Technology	T	3-0-0	3	3	ES (PC)
4.		Programme Elective – III	T	3-0-0	3	3	ES (PE)
5.		Programme Elective – IV	T	3-0-0	3	3	ES (PE)
6.		Programme Elective – V	T	3-0-0	3	3	ES (PE)
7.		Open Elective	T	3-0-0	3	3	-
8.		Self-Learning Course	--	--	0	1	-
9.		Industry Oriented Course – II	LIT	1-0-2	3	1	SD
Total Credits					**24**	**23**	
For Honours Degree							
1.		Capstone Design Project – Level I	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – I	T	3-0-0	3	3	
2.		Honours Elective – II	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – I	T	3-0-0	3	3	
2.		Minor Elective – II	T	3-0-0	3	3	

Semester – VII							
S. No.	Course Code	Course Name	Course Type	Periods / Week		Credits	Category
				L-T- P	TCP		
1.		Functional Foods and Nutraceuticals	T	3-0-0	3	3	ES (PC)
2.		Climate Change and Sustainability	T	2-0-0	2	2	HUM
3.		Engineering Entrepreneurship Development	T	2-0-2	4	3	HUM
4.		Food Safety, Regulations and Quality Assurance	T	3-0-0	3	3	ES (PC)
5.		Intellectual Property Rights in Food Technology	T	3-0-0	3	3	ES (PC)
6.		Food Packaging Technology	LIT	3-0-4	7	5	ES (PC)
7.		Food Plant Equipment Design	T	3-0-0	3	3	ES (PC)
8.		Summer Internship	---	---	---	1	SD
Total Credits					**25**	**23**	

For Honours Degree							
1.		Capstone Design Project – Level II	CDP	0-0-12	12	6	SD
OR							
1.		Honours Elective – III	T	3-0-0	3	3	
2.		Honours Elective – IV	T	3-0-0	3	3	
For Minor Degree							
1.		Minor Elective – III	T	3-0-0	3	3	
2.		Minor Elective – IV	T	3-0-0	3	3	

Semester – 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 No. of credits:175

Programme Elective Courses (PEC) - Streams

Dairy Technology	Meat, Poultry and Aquatic Technology)	Baking and Confectionery Technology	Agro-produce Technology	Food Safety Management System
Dairy Chemistry and Microbiology	Introduction to Meat, Poultry, and Aquatic Foods	Introduction to Baking and Bakery Products	Technology of Grains and Products	Introduction to Food Safety and Quality
Value-added Dairy Products	Meat and Poultry Processing	Flour Chemistry and Rheology	Technology of Oilseeds	Risk Assessment in Food Processing and Preservation
Quality and Safety Monitoring in Dairy Industry	Aquatic Foods Processing	Industrial Production of Bakery Products	Technology of Fruits and Vegetables	Food Product and Supply Chain Management
Precision Fermentation for Dairy Alternatives	Byproducts in Meat, Poultry and Aquatic Processing	Industrial Production of Confectionery Products	Technology of Plantation Crops	Food Laws – Indian and International
Cheese Technology	Preservation Technology of Meat, Poultry and Aquatic Foods	Laws and Regulations of Bakery and Confectionery Products	Technology of Spices, Medicinal, and Aromatic Crops	Food Safety in Hospitality Industries
Processing of Dairy Products	Technology of Packaging Meat, Poultry and Aquatic Products	Packaging of Baking and Confectionery Products	Laws and Regulations of Agro-produce	Food Analysis and Quality Control
Innovative Packaging of Dairy Products	Quality, Laws and Regulations in Meat, Poultry and Aquatic Industries	New Product Development in Baking and Confectionery	Supply Chain and Packhouse Operations of Agro-products	Food Quality Assurance

Semester I

MA25C01	Applied Calculus	L	T	P	C
		3	1	0	4

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

References:

1. Anton, H., Bivens, I. C., & Davis, S. (2021). Calculus: Early transcendentals. John Wiley & Sons.
2. Ron Larson and David C. Falvo,(2013), Calculus: an Applied Approach. Cengage

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

E-resources:

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

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

FD25101	Introduction to Food Technology	L	T	P	C
		2	1	0	3

Course Objective:

- Impart the fundamental knowledge of food science, food composition, processing and preservation techniques, food safety standards, and the structure of the Indian food industry.

Composition and Classification of Food Materials

Food components: carbohydrates, proteins, fats, water, enzymes; Nutritional and functional properties; Classification of foods: cereals, pulses, fruits, vegetables, meat, dairy

Activity: seminar on food groups and their nutritional roles

Food Processing Methods and Equipment

Unit operations in food processing: sorting, peeling, mixing, drying; Thermal and non-thermal techniques: pasteurization, freezing, irradiation; Introduction to food processing equipment and layout

Activity: virtual demonstration of food processing techniques.

Preservation and Packaging Technologies

Preservation techniques: physical, chemical, biological; Packaging materials: biodegradable, active packaging; Shelf life estimation and storage conditions

Mandated Activity: Poster Presentation on innovative packaging solutions.

Food Safety Standards and Regulatory Framework

Food laws and bodies: FSSAI, Codex, WHO; Hygiene practices, contaminants, HACCP and GMP; Traceability, labelling norms, consumer rights

Activity: Seminar on current global food safety challenges

Industry Overview and Emerging Trends in Food Technology

Indian food industry landscape; Career paths and institutional roles; Current trends: smart foods, nutraceuticals, sustainability

Activity: Report preparation on start-up idea in Food Tech.

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

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

References:

1. Potter, N. N., & Hotchkiss, J. H. (2012). *Food science*. Springer.
2. Fellows, P. J. (2017). *Food processing technology*. Woodhead Publishing.
3. Roday, S. (2015). *Food science and nutrition*. Oxford University Press.
4. Manay, S., & Shadaksharaswamy. (2014). *Foods: Facts and principles*. New Age International.
5. Srilakshmi, B. (2021). *Food science*. New Age International Publishers.

E-Resources:

1. NPTEL: Introduction to Food Technology
2. Swayam MOOC: Food Safety and Nutrition
3. FAO Food Safety Portal
4. FSSAI Official Website
5. Open Textbook Library – Food Studies

	Description of CO	PO	PSO
CO1	Explain basic components and classification of food materials	---	-
CO2	Identify methods and operations used in food processing	PO1(3)	PSO1(2)
CO3	Evaluate packaging systems and preservation methods	PO2(3)	PSO2(1)
CO4	Demonstrate understanding of food regulations and hygiene practices	PO5(2) PO11(1)	PSO3(2)

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

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

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

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

References:

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

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

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

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

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

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

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

References:

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

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)

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

Course Objective(s):

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

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

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

Activities: Virtual demonstration of thermal stress.

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

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

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

Activities: Virtual demonstration of propagation of EM waves

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

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

Activities: Virtual demonstration of Scanning Transmission Electron Microscope

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

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

Activities: Demonstration of sensors and applications of Lasers

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

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

References:

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

E-Resources:

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

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

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

Course Objectives:

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

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

Practical: Analysis of alkalinity, hardness and dissolved oxygen.

Activity: Coagulation of water sample using Alum

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

Practical: Preparation of nanoparticles by Sol-Gel method.

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

Practical: Conductometric titrations

Activity: Electrochemical cell demonstration

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

Practical:

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

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

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

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

Activities: Demonstration of battery pack in e-vehicles.

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

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

References:

1. Jain, P. C., & Jain, M. (2015). Engineering Chemistry (17th ed.). Dhanpat Rai Publishing Company (P) Ltd.
2. Dara, S. S. (2004). A Textbook of Engineering Chemistry. Chand Publications.
3. Sachdeva, M. V. (2011). Basics of Nano Chemistry. Anmol Publications Pvt Ltd.
4. Friedrich, E. (2014). Engineering Chemistry. Medtech.

E-Resources:

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

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

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

Course Objectives:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

References:

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

E-resources:

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

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

ME25C04	Makerspace	L	T	P	C
		0	0	4	2

Course Objectives:

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

List of Activities

(A). Dis-assembly & Assembly Practices

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

(B). Welding Practices

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

(C). Electrical Wiring Practices

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

(D). Electronics Components / Equipment Practices

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

(E). Contemporary Systems

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

References:

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

Course Outcomes:

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

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

Course Objectives

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

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

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

Course Objectives:

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

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

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

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

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

Weightage: Continuous Assessment: 100%

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

References:

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

E-resources:

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

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

Semester II

MA25C02	Linear Algebra	L	T	P	C
		3	1	0	4

Course Objectives:

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

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

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

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)

FD25201	Environmental Monitoring for Food Industries	L	T	P	C
		3	0	0	3

Course Objective

To impart knowledge of environmental challenges specific to food processing industries control strategies in food industries.

Introduction to Environmental Monitoring in Food Industries: Importance of environmental monitoring in food industries, Link to microbial contamination, spoilage, and public health, Overview of environmental issues in food processing: air, water, soil, noise, Types of environmental hazards : physical, chemical, microbial- Water consumption and wastewater generation- Energy use and carbon footprint, Good Manufacturing Practices (GMP) and hygienic zoning (low-, medium-, high-risk zones), Overview of ISO 14000 standards and EMS (Environmental Management Systems), Environmental hotspots in dairy, meat, and beverage sectors.

Activity: Report preparation IS14000 standards for the food industry.

Monitoring of Water, Air, and Surfaces: Water quality parameters (physical, chemical, microbiological), BIS, WHO, FSSAI Standards & Regulations, Wastewater characterization and effluent standards (CPCB, SPCB norms), Domestic vs industrial wastewater, Sampling protocols, Parameters monitored before discharge, Air quality monitoring: particulate matter, VOCs, odour emissions, Sampling equipment: high-volume samplers, gas analyzers, Odour threshold levels and mitigation strategies, Importance of indoor air quality in food processing, Surface and equipment hygiene monitoring (swab tests, ATP bioluminescence), Tools and instrumentation used in monitoring (HACCP-based approach)

Activity: List of the FASSAI standards for a food product.

Waste Management and Pollution Control: Types of waste: solid, liquid, gaseous in food processing, Packaging waste and plastics, Waste minimization and segregation strategies, Source reduction, substitution, process optimization, Recovery and reuse (e.g., whey in dairy, peel extracts), Lean manufacturing, circular economy principles, Wastewater treatment technologies (aerobic/anaerobic digestion, ETPs), Air pollution control: scrubbers, biofilters, Case studies of eco-friendly waste management in food industries (Biogas generation from dairy effluent, Zero Liquid Discharge (ZLD) in breweries)

Activity: Industrial visit of food industry ETP plant and report preparation.

Regulatory Framework and Compliance: National and international standards: FSSAI, BIS, CPCB, ISO, WHO, Codex, Environmental standards for air, water, and waste discharge - Occupational exposure limits, Environmental auditing and reporting, Consent to operate (CTO) and consent to establish (CTE) from pollution control boards, Compliance requirements and documentation, Environmental Clearance for large food industries, Risk assessment and management, Documentation and traceability (SOP, Regulatory inspection preparedness)

Activity: Report preparation for environmental clearance for a food industry.

Practical Approaches and Emerging Trends: Real-time monitoring technologies (Sensors, IoT-based systems, Cloud-based dashboards for decision-making), Data logging, analysis, and reporting: Interpreting trends & alarms, Root cause analysis, CAPA protocols, Sustainable and circular economy approaches: Renewable energy in food industries, Green building certifications (LEED, GRIHA), Water-positive and carbon-neutral food facilities, Role of Life Cycle Assessment (LCA), Green technologies and innovations in food industries, Case studies from dairy, meat, beverage, and bakery industries

Activity: case studies from dairy, meat, beverage, and bakery industries.

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

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

References

1. Jay J.M., Loessner M.J., Golden D.A. (2005). *Modern Food Microbiology*, Springer.
2. Arvanitoyannis, I. (2008). *Waste Management for the Food Industries*. Academic Press.
3. C.S. Bhatia (2001). *Environmental Pollution and Control in Chemical Process Industries*. Khanna Publishers.
4. FSSAI Manuals on Food Safety and Standards Regulations (www.fssai.gov.in)
5. ISO 14001: Environmental Management Systems – Requirements with Guidance for Use
6. CPCB Guidelines and Reports – www.cpcb.nic.in
7. BIS and WHO Environmental Monitoring Guidelines

	Description of CO	PO	PSO
CO1	Explain the sources of environmental pollution in food processing units.	--	-
CO2	Conduct environmental monitoring for air, water, and waste in food industries.	PO1(2) PO2(3)	PSO2(1)
CO3	Apply regulatory standards (like FSSAI, BIS, CPCB, ISO 14001) in environmental monitoring.	PO2(1) PO3(3)	PSO3(3)
CO4	Design and implement monitoring protocols and corrective actions in case of deviation.	PO2(3) PO3(1)	PSO1(1)
CO5	Recommend sustainable and eco-friendly practices for waste management and pollution prevention.	PO6(1) PO11(2)	PSO3(1)

FD25202	Principles of Thermodynamics	L	T	P	C
		3	0	0	3

Course Objective:
To provide the knowledge on fluids behaviour, laws of thermodynamics, thermodynamic relations, and their application to fluid flow, power generation, and refrigeration processes.

Basic Concepts: Scope of thermodynamics; Definition of system, control volume, state and path function, equilibrium, reversibility, energy, work, and heat; zeroth law; temperature scales PVT behavior of fluids; Mathematical representation of PVT behavior; Generalized compressibility factor correlation; Generalized equations of state.
Activity: Using Matlab, Excel calculations on ideal gases.

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

Activity: Using Matlab, Excel: energy calculations in closed and open systems

Properties of Pure Substance and Steam Power Cycle: Thermodynamic potentials – internal energy, enthalpy, Helmholtz free energy, Gibbs free energy; thermodynamic property relations, Maxwell relations, partial derivatives and Jacobian method; residual properties; thermodynamic property tables and diagrams

Activity: Demonstration simulation of Carnot and Rankine cycle, Matlab, Excel-based efficiency and calculation.

Thermodynamic Relations and Phase Equilibria: Partial molar properties, ideal and non-ideal solutions, standard states definition and choice, Gibbs-Duhem equation, excess properties of mixtures. Criteria for equilibrium between phases in multi-component non-reacting systems in terms of chemical potential and fugacity, application of phase rule, vapor-liquid equilibrium, phase diagrams for homogeneous systems and systems with a miscibility gap, effect of temperature and pressure on azeotrope composition, liquid-liquid equilibrium, ternary liquid-liquid equilibrium.

Activity: Measurement of vapour pressure or boiling point use of real gas EOS with software tool or Matlab Lab demo

Gas Mixtures and Psychrometry: Mole and Mass fraction, Dalton's and Amagat's Law. Properties of gas mixture – Molar mass, gas constant, density, and change in internal energy, enthalpy, entropy, and Gibbs function Psychrometric properties, Psychrometric charts. Property calculations of air vapor mixtures by using chart and expressions. Psychrometric process, adiabatic saturation, sensible heating and cooling, humidification, dehumidification, evaporative cooling and adiabatic mixing. Simple Applications

Activity: Demonstrate property estimation using Psychrometric charts.
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%
Assessment Methodology: Quiz (10%), Assignments (20%), Review of GATE Questions (20%), Internal Examinations (50%)
References: 1. Nag, P. K. (2001). *Thermodynamics* . Tata McGraw Hill. 2. Rathakrishnan, E. (2010). *Fundamentals of engineering thermodynamics*. PHI Learning. 3. Çengel, Y. A., & Boles, M. A. (2011). *Thermodynamics: An engineering approach* (7th ed.). Tata McGraw Hill. 4. Chattopadhyay, P. (2014). *Engineering thermodynamics*. Oxford University Press. 5. Venkatesh, A. (2007). *Basic engineering thermodynamics*. Universities Press (India) Limited. 6. Rathakrishnan, E. (2006). *Fundamentals of engineering thermodynamics* (2nd ed.). Prentice Hall of India Pvt. Ltd. 7. Van Wylen, G. J., & Sonntag, R. E. (1987). *Classical thermodynamics*. Wiley Eastern.

	Description of CO	**PO**	**PSO**
CO1	Explain the fundamental concepts of thermodynamics	--	-
CO2	Apply the second law and analyze the feasibility of systems/devices	PO1 (3) PO2 (1)	-
CO3	Apply the thermodynamic relations for the phase equilibria calaculation.	PO1 (3) PO2 (1) PO3(1)	PSO2(1)
CO4	Demonstrate the various charts to calculate the thermodynamic properties.	PO11 (1)	PSO3(2)

C25H02	தமிழர்களும் தொழில்நுட்பமும் / Tamils and Technology	L	T	P	C
		1	0	0	1

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

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

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

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

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

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

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

References

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

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)

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)
CO	Analyse physical systems and interpret data from the virtual studies in the core branches in technology streams.	PO2(2)	PSO1(2)

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

Course Objectives:

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

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

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

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

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

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

References:

1. Wang, W. (2010). Reverse engineering: Mechanisms, structures, systems & materials. CRC Press.
2. Margolis, M. (2020). Arduino cookbook: Recipes to begin, expand, and enhance your projects (3rd ed.). O'Reilly Media.

E-resources:

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

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

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)

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:

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)

FD25301	Food Microbiology	L	T	P	C
		3	0	4	5

Objectives:

- To develop a comprehensive understanding of the role of microorganisms in food systems, emphasizing their impact on food spoilage, preservation, fermentation processes, and regulatory diagnostics

Role of Microbes in Spoilage of Foods: Factors affecting spoilage of foods, microbial flora associated with various food groups and their spoilage potential. Microbiological spoilage problems associated with typical food products.

Practicals:

- Yeast and mould counts from fresh fruits; serial dilutions and Total Viable Counts (TVC) of spoiled foods.
- Enumeration of spores from pepper.
- Enumeration & isolation of *E. coli* from processed meat/chicken.
- Enumeration & isolation of Staphylococci from ready-to-eat street foods.

Activities: Case studies and interpretation of food contamination.

Group analysis of microbial spoilage kinetics in highly perishable foods

Control of Microbes in Foods: Use of antimicrobial chemicals - organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, benzoates, sorbates/propionates, naturally occurring antimicrobials; physical methods - low and high temperatures, drying, radiation and high pressure; tolerance of microbes to chemical and physical methods in various foods.

Practicals:

- Inhibitory effect of spices on microbial load in fish and flesh foods.
- Thermal destruction of microbes: Determination of Thermal Death Time (TDT) and Thermal Death Point (TDP) for pasteurized items.
- evaluation of cleaning and disinfection protocols on microbial load.

Activities: Case studies on emerging techniques in control of microbes in foods., Case studies exploring the synergistic mechanisms of hurdle technology options.

Microbes in Food Fermentations: Microbes of importance in food fermentations, homo & hetero-fermentative bacteria, yeasts & fungi; biochemistry of fermentations pathways involved, lactic acid bacteria fermentation and starter cultures, alcoholic fermentations - yeast fermentations - characteristics and strain selection, fungal fermentations. Microbes associated with typical food fermentations - yoghurt, cheese, fermented milks, breads, idli, soy products, fermented vegetables and meats.

Practicals:

- Isolation and enumeration of lactic acid bacteria from fermented food samples;

industrial microbiological quality analysis of raw milk.

Activities: Comparative presentation charting traditional versus industrial-scale millet or dairy fermentation systems.

Microbial Agents of Food Borne Illness: Foodborne infections and food poisoning, microbial toxins, Gram-Negative and Gram-Positive foodborne pathogens; toxigenic algae and fungi; Foodborne viruses; helminths, nematodes and protozoa.

Practicals:

- Enumeration and selective isolation of E. coli from processed meats and Staphylococci from ready-to-eat street foods; microbiological quality verification of water using the Most Probable Number (MPN) method.

Activities: Traceability analysis tracking real-world salmonellosis or listeriosis food outbreak case studies.

Microbial Examination of Foods: Detection & enumeration of microbes in foods; indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of foodborne pathogens; Applications of immunological techniques to food industry; Detection methods for *E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. botulinum & Salmonella, Listeria monocytogenes*, Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

Practicals:

- Introduction to laboratory safety, sterilization techniques, and media preparation; advanced staining, microscopy, and rapid analytical ELISA / biosensor test kits.
- Culture techniques: isolation and preservation (broth, plates, slants, stabs).
- Quantification of microbes: sampling, serial dilution, and Total Viable Count (TVC).

Activities: Rapid analytical kits for microbial testing of foods.

Flipped classroom critique regarding rapid biosensors versus standard plate techniques.

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

Assessment Methodology:

Continuous Assessment (50% Weightage):

- Internal Theory Examinations (Assessment 1 & 2): 40%
- Laboratory Practical Work Performance, Viva, and Records: 30%
- Module Activities Component: 30% *(Based on Flipped Class performance, Case Study reports, and Quizzes)*

End Semester Examination (50% Weightage):

Combined Theory (60% weightage) and Practical Objective Examination (40% weightage)

References:

1. Banwart, G.J. “Basic Food Microbiology” 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. “ Food Microbiology”. MJP Publishers, Chennai, 2007.
3. Jay, J.M. “Modern Food Microbiology”. 4th Edition. CBS Publishers, 2003.
4. Adams, M.R. and M.O. Moss.” Food Microbiology”. New Age International, 2002
5. Khetarpaul, Neelam. “Food Microbiology” Daya Publishing House, 2006.
6. Montville, Thomas J. and Karl R. Matthews “ Food Microbiology: An Introduction”. ASM Press, 2005
7. Ray, Bibek and ArunBhunia. “Fundamental Food Microbiology” 4th Edition, CRC Press, 2008
8. Pawsey, R. K. “Case Studies in Food Microbiology for Food Safety and Quality”. The Royal Society of Chemistry, 2001.
9. Forsythe, S.J. “The Microbiology of Safe Food”. Blackwell Science, 2000.
10. Doyle, Michael P. “Food Microbiology: Fundamentals and Frontiers”. 2nd Edition, ASM Press, 2001.

Harrigan, W.F. “Laboratory Methods in Food Microbiology” Academic Press, 2011.

E-Resources:

1. NPTEL Online Courses on Food Microbiology, Food Preservation, Fermentation Technology, and Food Safety Management, IITs and premier institutes of India**.**

CO Mapping with PO & PSO:

CO’s	CO Description	PO	PSO
CO1	Understand the intrinsic and extrinsic factors governing microbial growth, survival, and spoilage in raw and processed foods.	–	–
CO2	Apply thermal processing parameters (TDT/TDP) and hurdle technology principles to control microbial populations in foods.	PO1 (3)	PSO1 (2)
CO3	Analyze microbial metabolic pathways, starter cultures, and growth kinetics involved in commercial food fermentation processes.	PO2 (3)	PSO2 (2)
CO4	Evaluate food matrices for pathogenic microorganisms and contamination indicators using microbiological, immunological, and molecular techniques.	PO4 (3)	PSO2 (1)
CO5	Demonstrate sterile isolation, staining, enumeration, and microbiological diagnostic techniques following laboratory biosecurity practices.	PO5 (2)	PSO3 (1)

FD25302	Biochemistry and Human Nutrition	L	T	P	C
		3	0	4	5

Objectives:

- The course aims to give students a solid foundation in biomolecules with their metabolic pathways and the roles of each nutrient in metabolism and growth.

Introduction To Biomolecules: Basic principles of organic chemistry, isomers, and stereoisomers, types of functional groups in biomolecules, types of bonds and interaction in biomolecules, chemical nature of water, pH, and mechanism of action of buffers in biological system.

Practical: Preparation of buffer – titration of a weak acid and a weak base.

Activities: Chemistry Hidden in Food Molecules

Structure And Properties Of Important Biomolecules: Carbohydrates mutarotation, glycosidic bond, reactions of monosaccharides and reducing sugars, starch, glycogen, cellulose, and chitin. Proteoglycans, glycosaminoglycans. hyaluronic acid, chondroitin sulfate. Lipids – fatty acids, glycerol, triacylglycerol, phospholipids, glycolipids, sphingolipids. Inherited metabolic disorders of lipid metabolism – Tay-Saach's disease, Niemann- Pick's disease, and Gaucher's disease. Cholesterol, steroids, bile acids and salts, gluco- and minerals- corticosteroids. Prostaglandins and their functions. Lipoproteins. Cardiovascular disease and correlation with circulating lipid and lipoprotein concentration. Amino acids, peptides, and proteins. Classification based on side-chain properties. Structures, hierarchy of organization – primary, secondary, tertiary, and quaternary structures, glycoproteins, lipoproteins. Nucleic acids – purines, pyrimidines, nucleosides, nucleotides, Chargaff's rules. Base pairing, A-T and G-C, mRNA, rRNA, and tRNA. Watson-Crick structure of DNA, reactions, properties, Tm and hypochromicity, measurement of DNA and RNA. Nucleoprotein complexes

Practical:

- Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars
- Quantitative method for amino acid estimation using ninhydrin
- Protein estimation by Biuret, Lowry's, Bradford, and spectroscopic methods.
- Extraction of lipids and analysis by TLC

Activities: Biomolecule to Disease – Group activity on case-linked, model and data interpretation

An Overview of Nutrition And Energy Balance: Definition, six classes of nutrients, calculating energy values from food, using the RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations, Balanced diet planning, dietary guidelines, glycemic and non-glycemic carbohydrates, health effects of fiber and starch intake food groups, exchange lists, personal diet analysis, digestion, absorption and transport – anatomy and physiology of the digestive tract, and absorption of nutrients. Energy balance, body weight and body composition, health implications, obesity, BMR, and BMI calculations.

Practical:

- Nutritional anthropometry - Standards for reference – WHO, Body Mass Index and Reference Value.
- Techniques of measuring height, weight, head, chest, and arm circumference, waist-to-hip ratio, and skin-fold thickness.
- Calculation of the calories from nutrient composition of foods.

Activities: Dietary assessment studies in India.

Vitamins & Minerals: Nutritional and biochemical roles of vitamins and minerals. Food sources, daily requirements, absorption, biochemical & physiological roles, deficiencies, and toxicity. Water Soluble Vitamins – vitamin C, B complex vitamins, fat-soluble vitamins – A, D, E, and K – function, recommended intakes, toxicities, food sources of vitamin A, D, E, and K, and vitamin E. Water balance and recommended intakes, fluid/electrolyte balance, food sources, absorption, biochemical function, recommended intakes, deficiencies of minerals, sodium, potassium, phosphorus, calcium, iodine, iron, zinc, selenium, copper, fluoride, and chromium. Losses of vitamins and minerals during processing, restoration and fortification.

Practical:

Quantitate estimation of vitamin C

Activities: Demographic analysis of nutrient deficiencies in India.

Intermediary Metabolism and Regulation: Enzymes, introduction to biocatalysts, metabolic pathways, primary and secondary metabolites. Glycolysis, TCA cycle, gluconeogenesis, pentose phosphate shunt, glyoxalate shunt. Fatty acid synthesis and oxidation, reactions of amino acids, deamination, transamination, and decarboxylation, urea cycle, Bioenergetics – high energy compounds, the electronegative potential of compounds, respiratory chain, ATP cycle, calculation of ATP yield during oxidation of glucose and fatty acids.

Practical: Enzymatic assay – phosphatase from potato

Activities: Understanding the Metabolic Pathway Integration (Large Integrated Metabolic Map)

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

Assessment Methodology: Quiz (5%), Assignments (5%), Flipped Class (10%), Practical (20%), Internal Examinations (60%)

References:

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. “Nutritive Value of Indian Foods”. NIN, ICMR, 2004.
2. B. Srilakshmi. “Nutrition Science”. II Edition, New Age International (P) Ltd., 2002.
3. Mann, Jim and Stewart Truswell “Essentials of Human Nutrition”. 3rd Edition. Oxford University Press, 2007.
4. Gibney, Michael J., et al., “Introduction to Human Nutrition”. 2 nd Edition. Blackwell,2009.
5. Gropper, Sareen S. and Jack L. Smith “Advanced Nutrition and Human Metabolism”. 5th Edition. Wadsworth Publishing, 2008.
6. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. “Nutritive Value of Indian Foods”. NIN, ICMR, 2004.
7. Damodaran, S., K.L. Parkin and O.R. Fennema. “Fennema’s Food Chemistry”. 4th Edition, CRC Press, 2008
8. Belitz,H.-D, Grosch W and Schieberle P. “Food Chemistry”, 3rd Rev. Edition, SpringerVerlag, 2004.
9. Walstra, P. “Physical Chemistry of Foods”. Marcel Dekker Inc. 2003.
10. Owusu-Apenten, Richard. “Introduction to Food Chemistry”. CRC Press, 2005

List of Experiments:

1. Units of volume, weight, density and concentration measurements and their range in biological measurements. Demonstration of proper use of volume and weight measurement devices.
2. Preparation of buffer –titration of a weak acid and a weak base.
3. Qualitative tests for carbohydrates – distinguishing reducing from non-reducing sugars and keto from aldo sugars.
4. Qualitative method for amino acid estimation using ninhydrin.
5. Estimation of alpha amino nitrogen by Sorenson's formal titration
6. Protein estimation by Biuret method
7. Protein estimation by Lowry method
8. Extraction of lipids and analysis by TLC.
9. Nutritional anthropometry - Standards for reference – WHO, Body Mass Index and reference value
10. Techniques of measuring height, weight, head, chest and arm circumference, waist to hip ratio, skin-fold thickness, Calculation of percent Body fat using skin folds calipers
11. Calculation of the calories from nutrient composition of foods
12. Comparison of Food Composition data bases

E-Resources:

1. NPTEL Online Courses on Biochemistry, Biomolecules, Metabolism, Nutrition, and Molecular Biology, IITs and premier institutes of India

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the structure, classification, and functions of biomolecules in living systems.	–	–
CO2	Apply the concepts of biomolecular structure to explain the properties and functions of carbohydrates, lipids, amino acids, and nucleic acids.	PO1 (3)	PSO1 (2)
CO3	Analyze energy balance, nutritional requirements, and dietary assessment for maintaining health and metabolic activities.	PO2 (3)	PSO1 (2)
CO4	Evaluate the nutritional significance of vitamins, minerals, and other nutrients in human health, disease prevention, and dietary planning.	PO3 (3)	PSO2 (2)
CO5	Demonstrate the understanding of metabolic pathways and their regulation through problem-solving, case analysis, and interpretation of biochemical processes.	PO5 (2)	PSO3 (1)

FD25303	Stoichiometry in Food Industries	L	T	P	C
		2	1	0	3

Objectives:

The course aims

- To develop a fundamental understanding of process calculations,
- To enable students to apply material balance principles state processes in food and allied industries.
- To impart knowledge of the basic concepts and laws of Thermodynamics and their application in energy balance and process analysis.

Introduction: UNITs and dimensions, the mole UNIT, mole fraction (or percent) and mass fraction (or percent), analyses of a mixture, concentrations, basis of calculations, predicting P-V-T properties of gases using the following equations of state: ideal gas law, Van der Waals equation, Redlich-Kwong equation, calculation of density.

Activities: Practical applications of stochiometric calculations

Chemical Equation And Material Balances: Basics of chemical equation and stoichiometry, limiting reactant, excess reactant, conversion, selectivity, yield. Basic concepts involved in material balance calculations, material balance problems without chemical reactions: membrane separation, mixing, drying, crystallization. Basic concepts of recycle, bypass and purge streams.

Activities: Application of material balances in food industries

Basic Concepts And First Law Of Thermodynamics: Fundamental concepts of thermodynamics– systems, properties, process, functions, UNITs, energy, heat and work– Zeroth law. First law, internal energy, enthalpy, heat capacities CV and CP– steady flow processes with reference to various thermal equipments- nozzle, throat, throttling process and compressors.

Activities: Thermodynamics around us – Observe and discuss

Volumetric properties Of Pure Fluids: PVT behavior of pure substances, virial equations of state, the ideal gas, equations for process calculations(for an ideal gas in any mechanically reversible closed-system process): isothermal process, isobaric process, isochoric process, adiabatic process, and polytropic process. Application of the virial equations, introduction to cubic equations of state: van der Waals equation, Redlich/Kwong equation, theorem of corresponding states; acentric factor.

Activities: Comparative application based study on real gas vs ideal gas

Second Law Of Thermodynamics: Statements, heat engines, Carnot's theorem, ideal-gas temperature scale; Carnot's equations, concept of entropy, entropy changes of an ideal gas undergoing a mechanically reversible process in a closed system,

mathematical statement of the second law, entropy balance for open systems, statement of the third law. **Activities:** Application of 2nd law of thermodynamics in food industries

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%
Assessment Methodology: Quiz (10%), Assignments (10%), Flipped Class (10%), Internal Examinations (70%)
References: 1. Bhatt, B.L and Vora, S.M. Stoichiometry, 5th Edition, McGraw-Hill, New York, 2010. 2. Gavhane, K.A. Introduction to Process Calculations (Stoichiometery), Nirali Prakashan Publications, Pune, 2006. 3. Venkataramani, V. and Anantharaman, N. Process Calculations, Prentice Hall of India, New Delhi, 2003. 2. Himmelblau, D.M. Basic Principles and Calculations in Chemical Engineering, 6th Edition, Prentice Hall India, New Delhi, 2003.
E-Resources: 1. NPTEL Online Courses on Stoichiometry, Process Calculations, Material and Energy Balances, and Chemical Engineering Thermodynamics, offered by IITs and premier institutes.

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the concepts of units, dimensions, and ideal gas laws used in food process engineering calculations.	–	–
CO2	Apply fundamental food process calculations involving material quantities, compositions, and process variables.	PO1 (3)	PSO1 (2)
CO3	Analyze stoichiometric relationships and material balance equations in food processing operations.	PO2 (3)	PSO1 (2)
CO4	Evaluate energy requirements and energy balance calculations in food processing systems.	PO3 (3)	PSO2 (1)
CO5	Solve problems involving enthalpy changes and heat effects in food processing operations and thermal systems.	PO5 (2)	PSO3 (1)

FD25304	Fluid Mechanics and Mechanical Operations	L	T	P	C
		3	0	4	5

Objectives:

- To impart knowledge on the fluid properties and fluid statics principles
- To introduce the basic concept of fluid kinematics and dynamics
- To calculate the rate of flow and energy losses in flow through pipes and open channels
- To emphasize the concepts of boundary layer theory and the importance of dimensional analysis
- To impart the knowledge of pumps and turbines

Fluid Properties And Fluid Statics: Concept of Continuum, Properties of Fluid, Classification of fluids, Types of fluid flow Streamline, Streamlines, and path line, Pascals Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of fluid pressure Manometers, Buoyancy and meta-Centre, Stability analysis and applications.
Activities: Understanding Fluid Types and Flow Behavior in Food Industries.

Fluid Kinematics And Dynamics: Continuity equation, Velocity Potential and Stream function, Bernoullis equation, and its applications, Impulse-Momentum principle, Impact of Jet, Velocity triangle.
Activities: Application of principles of fluid kinematics and dynamics in beverage industries.

Flow Through Pipes And Channels: Laminar and turbulent flows in circular pipes, Major and Minor losses in pipes, Darcy Weisbach equation, Hagen Poiseuille equation, Multi reservoir problems, pipe network design, Types of open Channel flows, Measurement of discharge in open channels, Notches, Most economical channel section.
Activities: Case studies on limitations of flow through pipes and channels in food industries.

Dimensional Analysis And Model Testing: Buckingham's theorem and Application of theorem in fluid flow Reynolds, Froude, and Mach number and their applications in model testing, Boundary layer thickness, Momentum integral equation, Drag and lift, Separation of the boundary layer, and Methods of preventing the boundary layer separation.
Activities: Scale-up challenges from laboratory to food industry.

Hydraulic Machines: Centrifugal pumps, Work done, Head developed, Pump output and Efficiencies, priming - minimum starting speed, performance of multistage pumps, Cavitation, methods of prevention, Pump characteristics, Classification of hydraulic turbines, Pelton wheel, Francis turbine, Kaplan and turbines, Specific speed, Performance characteristics, Selection of turbines, Turbine efficiencies.
Activities: Application of hydraulic machines in food processing industries.

List of Experiments

1. Find the coefficient of discharge by suitable device that is most accurate to

measure the fuel and air distribution in the carburetor of an IC engine in a two wheeler Also, in Pasteurization and Sterilization process. Discuss the effects of the Reynolds number and friction factor in relation to the rate of flow.

2. Analyze the friction factor of various pipes in a distribution of a water supply for domestic applications.
3. Determine the coefficient of discharge by suitable device used to monitor and control the flow of water and chemicals in water treatment plants.
4. Analyze the Lift and drag force of an aerofoil design used in a windmill for power generation.
5. Conduct the performance test of a suitable turbine that is used to extract energy from waterfalls whose water drops down from a height of about 500 m to generate power in Hydropower station.
6. Conduct the test from which electricity is to be generated has its reservoir fully filled up during the rainy season and the level drops down during summer. A turbine has to be put up such that it can accommodate both cases in a hydropower station.
7. Determine the efficiency of a pump to pump water to a very high elevation, say >300 ft, and high viscous fluid used for an irrigation and Chocolate Industry.

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

Assessment Methodology: Quiz (10%), Assignments (10%), Flipped Class (20%), Internal Examinations (60%)

References

1. Yunus A Cengel, and John M Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill
   Education (India) Pvt Ltd, 2014
2. Dr R.K. Bansal , A textbook of Fluid Mechanics and Hydraulic Machines, Tenth Edition, Laxmi Publications, New Delhi, 2018
3. Frank M White, Fluid Mechanics, McGraw Hill Publishing Company Ltd, New Delhi, 8th Edition 2017
4. R C Hibbler, Fluid Mechanics, Pearson, First edition, 2017
5. S K Som and G Biswas, Introduction to Fluid Machines, 3rd Edition, McGraw-Hill Education 2017

E-Resources:

1.SWAYAM MOOCs on Fluid Flow Operations, Hydraulic Engineering, and Industrial Fluid Transport Systems

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the properties of fluids under static, kinematic, and dynamic conditions.	–	–
CO2	Apply fundamental equations of fluid flow to solve engineering problems involving fluid motion.	PO1 (3)	PSO1 (2)
CO3	Apply physical laws and principles in flow measurement systems and hydraulic operations used in food processing industries.	PO2 (3)	PSO1 (2)
CO4	Analyze flow characteristics in pipes, open channels, and industrial fluid transport systems.	PO3 (3)	PSO2 (2)
CO5	Evaluate the selection, performance, and efficiency of pumps and hydraulic equipment for food engineering applications.	PO5 (2)	PSO3 (1)

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

Course Objectives:

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

List of Activities

A. Elements of Effective Speaking and Listening

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

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

(iii) Welcoming a Guest Speaker at a Seminar

(iv) Pictography to represent data using images or symbols

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

B. Mastering Presentations

(i) Presentation Skills – Non-verbal communication

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

(iii) Technical Presentations with PPT

C. Group Discussion Strategies:

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

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

(iii) Group Discussions – Abstract and Factual topics

D. Resume & LinkedIn Optimization

(i) Building LinkedIn Profile – Drafting headlines and summaries

(ii) Social Media Optimisation

(iii) Preparing Video Resume

E. Podcast-Based Language Learning:

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

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

F. Mock Interviews and Communication Strategies:

(i) Listening – Job interview

(ii) Speaking – Mock interviews

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

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

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

References:

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

E-resources:

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

CO Mapping with PO & PSO:

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

Semester IV

MA25C13	Probability and Statistics	L	T	P	C
		3	1	0	4

Course Objectives: The Objectives of the course are to introduce data collection methods, classification techniques, and graphical representation of data using charts and plots, to explain the fundamental concepts of descriptive statistics, probability theory, random variables, and hypothesis testing for analyzing data and to demonstrate the application of statistical techniques such as experimental design and process control using R/Python for data-driven decision-making.

Descriptive Statistics: Collection of Data-Classification-Tabulation-Graphical Representation – Simple Bar Chart – Pie Chart -Measures of Central Tendency: Arithmetic Mean, Median and Mode – Measures of Variation: Range, Quartile Deviation - Standard Deviation and Coefficient of Variation – Five Number Summary – Box Plot Technique.

Activities: Application of descriptive statistics and data presentation methods using R/ Python programming and Analysing data using Box Plots using R/ Python programming.

Probability and Random Variables: Axioms of probability - Conditional probability – Total probability – Bayes' theorem Random variable – Distribution function – properties – Probability mass function – Probability density function – Moments - Standard Distributions - Binomial, Poisson and Normal Distributions-Problems, Uniform Distribution and Exponential Distribution (Simple Problems)

Activities*:* Application of various distributions using R/ Python programming.

Two-Dimensional Random Variables : Joint distributions – Marginal and conditional distributions – Expected values of functions of two variables– Correlation and regression (for discrete data only) - Central limit theorem – Statement and Simple Problems

Activities: Applications of Correlation and Regression using R/ Python programming.

Testing of Hypothesis: Large sample tests for single mean and difference of means – Small samples tests based on t and F distributions (single mean, difference of means, paired t- test and variance ratio test) – Chi-square test for independence of attributes and goodness of fit.

Activities: Application of Student – t test, F test ,Chi –s square test using R/ Python programming.

Design of Experiments: Analysis of Variance (ANOVA) – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD)

Activities: Application and visualization of One-way ANOVA and Two -way ANOVA using R/ Python programming.

Weightage: Continuous Theory Assessment: 20%, Continuous Lab Assessment: 20%, End Semester Examinations: 60%

Assessment Methodology: Quiz - 10%, Assignments - 20%, Lab Manual - 15% Lab Examination - 15%, Internal Examinations - 40%

References:

1. Walpole R. E., Myers S.L. & Keying Ye, "Probability and Statistics for Engineers and Scientists", Pearson Education Inc, 9th edition, 2024.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, "An Introduction to Statistical Learning with Applications in R", Springer, 2021.
3. Johnson R. A., Miller & Freund's, "Probability and Statistics for Engineers", 9th Edition, Pearson Education, Delhi, 2020.
4. Charles Henry Brase and Corrinne Pellillo Brase, "Understandable Statistics: Concepts and Methods", Cengage Learning, 12th Edition, 2018.
5. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, 2012.
6. Anderson, T. W, "An Introduction to Multivariate Statistical Analysis", 3rd edition, John Wiley and Sons, 2009.

E-resources:

1. NPTEL – Descriptive Statistics with R Software - https://onlinecourses.nptel.ac.in/noc22_mg87/preview
2. MIT OCW – Introduction to Probability and Statistics (18.05, Spring 2022) - https://ocw.mit.edu/courses/18-05-introduction-to-probability-and-statistics-spring-2022/
3. MIT OCW – Statistics for Applications (18.650, Fall 2016) - https://ocw.mit.edu/courses/18-650-statistics-for-applications-fall-2016/
4. Control Charts – Coursera: https://www.coursera.org/learn/stability-and-capability-in-quality-improvement#modules

	CO Description	PO Mapping	PSO
CO1	Understand concepts of descriptive statistics, probability theory and testing of hypothesis.	-	-
CO2	Apply probability distributions and statistical methods to solve engineering problems	PO1(3)	PSO1(1)
CO3	Analyze data using correlation, regression, and probability models.	PO2(3)	PSO1(2) PSO3(1)
CO4	Utilize hypothesis testing, ANOVA for data-driven decision-making.	PO5 (3) PO11 (2)	PSO2(2)

FD25401	HEAT AND MASS TRANSFER IN FOOD PROCESSING	L	T	P	C
		3	0	4	5

Objectives:

- To familiarize conduction heat transfer mechanisms; to expose the mechanisms of free and forced convection; to develop shape factor algebra for radiation; to demonstrate phase change mechanics in heat exchangers; and to master molecular diffusion and convective mass transfer principles.

Conduction: Introduction - Steady State Conduction in one and two-dimensional systems - Composite systems - Extended surfaces.

Practical:

Determination of the thermal conductivity of a material; unsteady heat transfer boundary estimation; calculation of the overall heat transfer coefficient (U) inside a packed bed heat exchange network. Determination of heat transfer co-efficient of double pipe heat exchanger.

Activities: Application of conduction in food industries. Numerical spreadsheet modeling mapping unsteady-state freezing intervals within cold storage zones.

Convection: Basic concepts - Heat transfer coefficients - Boundary layers - Forced convection - External and Internal flows - correlations - Natural convection.

Practical:

Experimental determination of heat transfer coefficients by natural and forced convection mechanisms; calculation of molal humidity profiles using an industrial cooling tower pilot plant. Determination of economy and thermal efficiency of rotary flash evaporator.

Activities: Application of convection in food industries. Mathematical problem-solving sessions optimizing forced convection air paths inside commercial blast freezers.

Radiation and Heat Exchangers: Radiation heat transfer concept of black and grey body - monochromatic Total emissive power Kirchhoff's law Planck's law - Stefan-Boltzmann's law. Heat exchangers parallel, counter and cross flow- Logarithmic Mean Temperature Difference (LMTD) overall coefficient of heat transfer in shell and tube heat exchanger for food products.

Practical:

Determination of the Stefan-Boltzmann constant and surface emissivity; performance testing of liquid drying rate mapping using tray dryers and pan dryers.
Determination of heat transfer co-efficient using pan dryer.

Activities: Application of radiation and heat exchangers in food industries. Sizing calculations comparing shell-and-tube versus plate exchangers for processing highly viscous dairy or beverage streams.

Introduction to Mass Transfer: Basics of mass transfer - Fick's laws of diffusion - mechanisms of mass transfer - Molecular diffusion, Fick's first and second laws, steady-state and non-steady-state diffusion, diffusion in solids and liquids, diffusion coefficients.

Practical: Performance evaluation and mass balance execution of simple distillation and packing tower systems.

Activities: Role of Mass Transfer in Food Processing and Everyday Foods. Solving

molecular gas diffusion boundary layer constants inside modified atmosphere packaging (MAP) configurations.

Convective Mass Transfer: Fundamentals of convective mass transfer, boundary layer theory, mass transfer coefficients in laminar and turbulent flow, dimensionless numbers, applications of mass transfer in bio and food industries.

Practical:

Performance evaluation of multi-component steam distillation and bubble-cap fractionation columns.

Activities: Application of convective mass transfer to real food processes. Industrial simulation project mapping convective moisture loss and oil absorption profiles during long-duration deep-fat frying.

List Of Experiments

1. Determination of thermal conductivity for one dimensional steady state conduction
2. Determination of heat transfer co-efficient by unsteady heat transfer
3. Determination of heat transfer co-efficient by natural convection
4. Determination of heat transfer co-efficient by forced convection
5. Determination of Stefan-Boltzmann constant
6. Determination of emissivity using emissivity apparatus
7. Determination of overall heat transfer for film wise and drop wise condensation
8. Determination of overall heat transfer co-efficient for a parallel and counterflow heat exchange
9. Experimentation on mass transfer
10. Determination of overall heat transfer co-efficient for a fluidized bed heat transfer

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

Assessment Methodology:

Continuous Assessment (50% Weightage):

- Internal Theory Examinations (Assessment 1 & 2): 40%
- Laboratory Practical Work Performance, Lab Viva, and Journals: 30%
- Module Activities Component: 30% *(Calculated from numerical modeling assignments, software-based simulations, and quizzes)*

End Semester Examination (50% Weightage):

- Combined Theory (60% weightage) and Practical Engineering Examination (40% weightage)

References

1. Yunus A. Cengel, Heat and Mass Transfer: Fundamentals and Application, Tata McGraw Hill publishing Company private limited, New Delhi, 6th edition, 2020
2. J. P. Holman, Heat Transfer, Tata McGraw Hill publishing Company private limited, New Delhi, 10th edition, 2010
3. C. P. Kothandaraman and S. Subramanyan, Fundamentals of Heat and Mass Transfer, New Age International private limited, New Delhi, Rev.3rd edition, 2006
4. Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt, Principles of Heat and Mass Transfer, ISBN: 978-1-119-38291-1 October 2017
5. R. K. Rajput, Heat and Mass Transfer, S Chand and Company, New Delhi, 2018

E-Resources:

1. LearnChemE and MIT OpenCourseWare resources on Conduction, Convection, Radiation, Heat Exchanger Design, Drying Operations, and Thermal Analysis.

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the principles of steady-state and unsteady-state heat conduction in composite food processing systems.	–	–
CO2	Apply convective heat transfer principles and determine heat transfer coefficients using dimensionless correlations and thermodynamic relationships.	PO1 (3)	PSO1 (2)
CO3	Design heat exchanger systems using LMTD and NTU methods for food processing applications involving different fluid properties and viscosities.	PO3 (3)	PSO1 (2)
CO4	Analyze molecular diffusion and mass transfer phenomena using Fick's laws across liquid, gaseous, and biological systems.	PO2 (3)	PSO2 (2)
CO5	Evaluate the performance and efficiency of industrial mass transfer operations such as distillation, drying, and dehydration processes.	PO4 (3)	PSO3 (1)

FD25402	Food Chemistry	L	T	P	C
		3	0	4	5

OBJECTIVES

- Understand the properties and composition of food
- Assess the role of nutrients in food
- Evaluate the effect of processing on nutrients in food

Carbohydrates In Food: The principal carbohydrates in the human diet. Chemical properties of carbohydrates-dehydration, caramelization, Maillard reaction. Types Simple Sugars: mono and disaccharides, solubility; Artificial sweeteners; Glucose syrup, fructose syrup, Sugar alcohols; Oligosaccharides: structure, nomenclature, occurrence, uses in foods. Polysaccharides: Starch-amylose and amylopectin- properties, thickening & gelatinization, modified starches, resistant starch, Dextrins and dextrans, Starch hydrolysates – Maltodextrins and dextrins; Structure of glycogen. Fiber- Cellulose & hemicellulose Pectins: Gums & seaweeds- gel formation & viscosity.

Practical:

Experiment on enzymatic and acid hydrolysis of sucrose
Experiments to study the gelling properties of starch

Activities: Current trends on low glycemic index foods in the market.

Proteins In Food: Proteins: Sources, Amino acids - classification, structure of protein, Nutritional Aspects: essential amino acids, biological value, Protein Efficiency Ratio (PER), Amino acid score, Protein digestibility, PDCAAS; Functional properties of proteins in food and industrial importance. Processing induced functional and nutritional changes in protein.

Practical:

Determination of Foaming properties of proteins
Experimental study of gluten formation using wheat flour
Determination of iso-electric point of casein & experiment to study the effect of rennin on milk proteins

Activities: Case studies on alternate proteins.

Fats And Oils In Food: Fats -Sources, structure and classification of fatty acids, Nomenclature, Isomerism, essential fatty acids; Properties: Crystal formation, polymorphism, melting point, smoke point, Flash point, fire point and emulsification. Deep fat frying: physical, chemical and nutritional changes. Hydrolytic and Oxidative rancidity. Quality analysis: Iodine value, Peroxide value, Saponification value, Free fatty acid test. Fat Modification: Hydrogenation, Winterization and Inter-esterification.

Practical:

Determination of Solubility, specific gravity, and Refractive index of oils
Estimation of the free fatty acid content of oil
Determination of peroxide value and Anisidine value of fats.

Activities: Case studies on fat replacers.

CHEMICAL AND NUTRITIONAL CHANGES OF FOOD DURING PROCESSING : Enzymatic browning of food, Chemical Changes in food during process-alterations of natural pigments, formations of heterocyclic aromatic amines, acrylamide, 5-hydroxymethylfurfural, furan, nitrosamines and acrolein. Stability and loss of Mineral & vitamin content of foods, off- flavors & food taints

Practical:

Experiment to study the non-enzymatic and enzymatic browning of foods.

Activities: Case study – Carcinogenic components in processed foods

AROMA & IMPORTANT PHYTOCHEMICALS IN FOOD: Naturally occurring colors/pigments in food and impact on antioxidant level, natural food grade Colors, flavor & aroma components present in herbs, spices, coffee, tea, cocoa, fruits, vegetables &fermented products; and naturally similar /artificial flavors, Threshold values. Naturally occurring toxic substances, protease inhibitors, bioactive components phytates, polyphenols, saponins, phytoestrogens, and other compounds.

Practical:

Study on isolation and properties of saponins from food.

Activities: Case study – Emerging phytochemicals from food as medicine

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

Assessment Methodology: Quiz (10%), Assignments (10%), Flipped Class (20%), Internal Examinations (60%)

List Of Experiments

1. Identification of edible water based on standards
2. Proximate analysis of carbonated beverages available in market
3. Comparison of vitamin C content in Natural extracted fruit juice and other beverages
4. Compare the protein efficiency of different food product by applying the different estimation method
5. Identification of starch content in bread and potatoes.
6. Analysis of fat content in dairy product
7. Determination of Solubility, specific gravity and Refractive index of oils
8. Estimation of free fatty acid content of oil
9. Verification of nutritional information in different brand biscuits available in the market.

References

1. Cox, M.M. and Nelson, David L. Lehninger, Principles of Biochemistry, Fifth Edition, H. Freeman, 2008
2. Murray, Robert K. et al., Harper's Illustrated Biochemistry, 28th Edition, McGraw Hill Professional, 2009.
3. Satyanarayana, U. Biochemistry Books and Allied, Fourth Revised Edition, Elsevier, 2013.
4. Belitz H-D, Grosch W and Schieberle P, Food Chemistry, Fourth Revised and Extended Edition, Springer- Verlag Berlin Heidelberg, 2009.
5. Vaclavik, V. A. and Christian, E. W, Essentials of Food Science, Third Edition, Springer Science & Business Media, 2007
6. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Alpha Science International Limited, 2010

E-Resources:

1.NPTEL Online Courses on Heat Transfer, Heat Exchanger Design, Mass Transfer Operations, Diffusion, Distillation, and Drying, offered by IITs and premier institutes.

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the structure, classification, and properties of carbohydrates.	–	–
CO2	Explain the structure, properties, and functions of proteins in food systems.	PO1 (3)	PSO1 (2)
CO3	Apply the concepts of lipid chemistry to explain their functional and nutritional roles in foods.	PO2 (3)	PSO1 (2)
CO4	Analyze the chemical and nutritional changes occurring in foods during processing and storage.	PO3 (3)	PSO2 (2)
CO5	Evaluate the role and significance of phytochemicals in food quality, functionality, and human health.	PO4 (3)	PSO3 (1)

FD25403	FOOD ADDITIVES AND FLAVORS	L	T	P	C
		3	0	0	3

Objectives:

- To provide comprehensive understanding of food additives, including their classification, functions and safety considerations in food processing and preservation.
- To delve into the science of flavor compounds, covering their development, extraction and analytical techniques.
- To addresses the regulatory frameworks and safety evaluations governing food additives,

Fundamentals Of Food Additives: Food additives-definitions, classification and functions, preservatives, antioxidants, colours and flavors (synthetic and natural), emulsifiers, sequestrants, humectants, hydrocolloids, sweeteners, acidulants, buffering salts, anticaking agents, etc. - chemistry, food uses and functions in formulations; indirect food additives; toxicological evaluation of food additives.

Activities: Additive Classification & Function Mapping

Preservatives And Antioxidants: Preservatives: definition, types, mode of action, factors affecting their performance, active forms of preservatives, necessity in food and levels of usage, permitted preservatives, and their food applications. Antioxidants: definition, natural and artificial antioxidant and their chemical structure, water soluble and oil soluble antioxidants, chemical structure, mechanism of action, permitted antioxidants permitted levels, and food application.

Activities: Analysis and testing of antioxidants in food

Food Colorants, Emulsifiers And Stabilizers: Natural and synthetic colorants; their chemical structure, permitted list of colors, usage levels; Non permitted colorants restriction on the use of colors in foods. Emulsifier and Stabiliser: Introduction, emulsion and its types, surface tension, hydrophilic and lipophilic balance (HLB), different classes of emulsifiers and their chemical structure, role of emulsifiers, role of different stabilisers and other substances in emulsion stability, emulsion formation process and equipment, permitted level of emulsifiers and stabilisers used in the food industry, and its food applications.

Activities: Market Survey and Label Analysis of Food Additives in Commercial Food Products

Legislation and Laws Governing Food Additives: INS numbering system. Legal and regulatory: general standards for food additives, FSSAI, CODEX and GMP to maintain the safety requirements of food additives. Food additive intake assessment methods, the role of JECFA in the safety assessment of food additives, ADI Calculation and procedures to fix ADI, permitted levels of food additives. Determination of the limits for addition. Contaminants. Pesticide residues in food. Methods to determining toxicity. Food contaminants from industrial wastes-heavy metals, polychlorinated polyphenyls, dioxins.

Activities: Case study on JECFA Monograph of food additives

Food Flavors And Quality Control: Introduction – Classification - flavor forms: water soluble liquid flavors – oil soluble liquid flavors, emulsion based flavors, dispersed flavors, spray dried flavors – commercial considerations - Flavor characteristics – Flavor compounds - Natural and artificial flavoring materials - Flavoring constituent of various foods like meat, fish, milk, vegetables, fruits, fats & oils, spices & herbs, cereals and pulses. Changes in flavoring components and characteristics during cooking/processing of various foods. Effects of storage, processing, transportation and environmental conditions on flavor components/constituents. Quality Control – analytical, sensory and adulteration testing. Measurement of flavor, particularly for wine, tea, coffee, species and condiments.

Activities: Sensory Evaluation of Foods Using Different Sensory Tests

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

Assessment Methodology: Quiz (10%), Assignments (10%), Flipped Class (20%), Internal Examinations (60%)

References:

1. Branen, A. L. “Food Additives” 2nd Edition, CRC press, 2002
2. Mahindru, S. N. “Food Additives- Characteristics Detection and Estimation”, TATA McGraw-Hill, 2000
3. Titus A. M. Msagati. “The Chemistry of Food Additives and Preservatives”, Wiley-Blackwell, 2013
4. Mahindru, S.N. “Food Additives: Characteristics, Detection and Estimation”. Tata McGraw-Hill, 2000.
5. Jim Smith and Hong Shum, “Food Additives data book”. 2nd Edition, Wiley Blackwell publishers (e-Book) 2011.
6. Thomas. E. Furia, “CRC Handbook of food additives” 2nd edition, Volume 1, CRC press, 1978
7. Thomas. E. Furia, “CRC Handbook of food additives” 2nd edition, Volume 2, CRC press, 1980
8. P. Michael Davidson, John N. Sofos, and A. L. Branen, “Antimicrobials in food”, 3rd edition, CRC press 2005
9. Peter A Williams and Glyn O Philips, “Gums and stabilizers for the Food Industry”, RSC,2006.
10. Madhavi, D. L., “Food antioxidants”, CRC Press, 1996
11. Helen Mitchell, “Sweeteners and sugar alternatives in food technology”, Blackwell, 2006
12. Carmen Socaciu, “Food Colorants”, CRC Press, 2008

Gary Reineccius, “Flavor chemistry and technology”, 2nd edition, CRC Press, 2005

E-Resources:

1.NPTEL Online Courses on Food Chemistry, Food Processing and Food Safety

2. SWAYAM MOOCs on Food Safety and Quality Management

CO Mapping with PO & PSO:

CO's	CO Description	PO	PSO
CO1	Understand the significance of antimicrobial agents, antioxidants, and acidity regulators used in food preservation.	–	–
CO2	Apply the principles of food additives to select suitable textural enhancers for food formulations.	PO1 (3)	PSO1 (2)
CO3	Analyze the properties and applications of food colours, functional ingredients, and food flavours for different food products.	PO2 (3)	PSO2 (2)
CO4	Evaluate flavour classifications and their behavior during formation, processing, and storage of foods.	PO3 (3)	PSO2 (1)
CO5	Evaluate flavour perception mechanisms and instrumental techniques used for flavour analysis in foods.	PO5 (2)	PSO3 (1)

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

Course Objectives:

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

List of Activities

Stage Ready – Impactful Public Speaking .

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

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

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

Professional and Application-Oriented Writing

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

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

Receptive Skills in Workplace Communication·

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

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

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

Intercultural Communication

(i) Assertive vs Aggressive communication

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

From Campus to Career: Industry Skills and Global Exam Preparation

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

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

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

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

End Semester Assessment:

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

References:

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

E-resources:

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

CO Mapping with PO & PSO:

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

FD25404	STANDARDS IN FOOD TECHNOLOGY	L	T	P	C
		1	0	0	1

OVERVIEW OF STANDARDS:

- Basic concepts of standardization; objectives and importance of standards in food industries; conformity assessment, certification, inspection and accreditation systems. Purpose of standardization in food quality, safety, sustainability, international trade and consumer protection. Marking and certification of food products and processes. Role, structure and functions of: Bureau of Indian Standards (BIS),Food Safety and Standards Authority of India (FSSAI),International Organization for Standardization, International Electrotechnical Commission, World Trade Organization and Codex Alimentarius Commission. BIS Act (latest amendments), ISO/IEC Directives, WTO–TBT & SPS agreements, Good Regulatory Practices. Emerging standards for digital traceability, blockchain in food supply chains, ESG and sustainability standards, circular economy standards, packaging and eco-labeling norms.

FOOD STANDARDS AND REGULATORY FRAMEWORK: Food quality grading and certification systems: AGMARK standards, Quality Council of India initiatives, Organic certification systems, GI tagging of food products. FSSAI regulations: licensing, registration, labeling, claims, nutraceuticals, novel foods, imports and exports. Food category systems, HS Code, Codex food classification, product-specific and commodity standards. Permitted food additives, contaminants, heavy metals, pesticide residues, veterinary drug residues, mycotoxins, allergens. Microbiological criteria and hygiene standards. Approval procedures for non-specified foods, new ingredients, plant-based alternatives, functional foods. Food Product Approval Systems and regulatory submissions.

Vertical and horizontal standards. Food safety auditing, GMP, GHP, HACCP, ISO 22000, BRCGS, FSSC 22000, retailer standards. Recall management, traceability systems and crisis management.

Activities: Case study on food traceability and recall

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

Assessment Methodology: Quiz (10%), Assignments (10%), Flipped Class (20%), Internal Examinations (60%)

REFERENCES

1. **Lasztity, R. (2009).** *Food Quality and Standards.* EOLSS Publishers, United Kingdom.
2. **Gupta, R.K., Dudeja, P., & Minhas, A.S. (2017).** *Food Safety in the 21st Century: Public Health Perspective.* Elsevier, United Kingdom.
3. **Motarjemi, Y., & Lelieveld, H. (2014).** *Food Safety Management: A Practical Guide for the Food Industry.* Academic Press.
4. **FAO & WHO. (2020).** *The Future of Food Safety – Transforming Knowledge into Action for People, Economies and the Environment.* Rome.

5. **Mortimore, S., & Wallace, C. (2013).** *HACCP: A Practical Approach.* Springer.
6. **Sikora, T., & Strada, A. (2021).** *Food Quality and Consumer Value: Delivering Food that Satisfies.* Springer.
7. **Bhat, R., & Rao, V.A. (2022).** *Food Quality Evaluation and Shelf Life Assessment.* CRC Press.
8. **Fellows, P.J. (2016).** *Food Processing Technology: Principles and Practice.* Woodhead Publishing.

E-Resources:

1.Food Safety and Standards Authority of India (FSSAI)

2. Bureau of Indian Standards (BIS)

3.FSSC 22000 Food Safety Certification.