DHANALAKSHMI SRINIVASAN
COLLEGE OF ENGINEERING
(AUTONOMOUS)
COIMBATORE - 641 105 | www.dsce.ac.in

DEPARTMENT OF FOOD TECHNOLOGY

REGULATIONS-2024

B.Tech – FOOD TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS)

NH -47, Palakkad Main Road, Post, Navakkarai,
Coimbatore-641 105
Tamil Nadu, India

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DEPARTMENT OF FOOD TECHNOLOGY
CHOICE BASED CREDIT SYSTEM (CBCS)
SEMESTER I

S. No.	Course Code	Course Title	Category	L	T	P	Contact Hours	C
THEORY								
1	HS24001	Communicative English – I	HSM	3	0	0	3	3
2	MA24001	Engineering Mathematics – I	BS	3	1	0	4	4
3	PH24001	Engineering Physics	BS	3	0	0	3	3
4	CY24002	Chemistry for Life Sciences	BS	3	0	0	3	3
5	ES24001	Engineering Graphics	ES	2	0	4	6	4
6	TA24001	Heritage of Tamils	HSM	1	0	0	1	1
7	MN24001	Overview of Engineering and Technology	MN	3	0	0	3	0
PRACTICALS								
8	BS24001	Engineering Physics & Chemistry Laboratory	BS	0	0	4	4	2
9	ES24002	Engineering Practices Laboratory	ES	0	0	4	4	2
10	HS24002	Communicative Laboratory	HSM	0	0	2	2	1
TOTAL				**18**	**1**	**14**	**33**	**23**

SEMESTER II

S. No	Course Code	Course Title	Category	L	T	P	Contact Hours	C
THEORY								
1.	HS24003	Communicative English II	HSM	3	0	0	3	3
2.	MA24002	Statistics and Numerical Methods	BS	3	1	0	4	4
3.	EE24003	Basic Electrical & Electronics Engineering	ES	3	0	0	3	3
4.	CS24001	Problem Solving and Python	ES	3	1	0	4	4

		Programming						
5.	FD24201	Biochemistry and Nutrition	PC	3	0	0	3	3
6.	TA24002	Tamils and Technology	HSM	1	0	0	1	1
7.	MN24002	Environmental Science and Sustainability	MN	3	0	0	3	0
PRACTICALS								
8.	FD24211	Biochemistry and Nutrition Laboratory	PC	0	0	4	4	2
9.	CS24002	Problem Solving and Python Programming Laboratory	ES	0	0	4	4	2
TOTAL				**19**	**2**	**8**	**29**	**22**

SEMESTER– III

S. No	Course Code	Course Title	Category	L	T	P	Contact Hours	C
THEORY								
1.	MA24306	Fourier and Laplace Transform	BS	3	1	0	4	4
2.	FD24301	Introduction to IoT in Food Processing	PC	3	0	0	3	3
3.	FD24302	Computational Fluid Mechanics in Food Processes	PC	3	0	0	3	3
4.	FD24303	Food Process Calculations	PC	3	0	0	3	3
5.	FD24304	Food Microbiology	PC	3	0	0	3	3
6.	FD24321	Food Chemistry	PC	2	0	4	6	4
PRACTICALS								
7.	FD24311	Food Microbiology Laboratory	PC	0	0	4	4	2
TOTAL				**17**	**1**	**6**	**25**	**22**

SEMESTER – IV

S. No	Course Code	Course Title	Category	L	T	P	Contact Hours	C
THEORY								
1.	MA24402	Probability and Statistics	BS	3	1	0	4	4
2.	FD24401	Thermodynamics for Food Technologists	PC	3	0	0	3	3
3.	FD24402	Transport Phenomena and Unit Operations in Food Processes	PC	3	1	0	4	4
4.	FD24403	Instrumentation and Process Control in Food Processing	PC	3	0	0	3	3
5.	FD24404	Smart Optimization Approaches in Food System	PC	3	0	0	3	3
PRACTICALS								

6.	FD24411	Instrumentation for Food Analysis Laboratory	PC	0	0	4	4	2
7.	FD24412	Unit Operations Laboratory	PC	0	0	4	4	2
TOTAL				**15**	**2**	**8**	**25**	**21**

HS24001–COMMUNICATIVE ENGLISH-I								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	0	0	45	3	40	60	100

Course Objectives

- To enable learners to understand the basics of communication.
- To empower learners to use narrative techniques to convey ideas and experiences in academic and work environment.
- To support learners in enhancing their linguistic competence and engaging in effortless dialogue.
- To assist learners in mastering language for the successful academic and professional communication.
- To strengthen language proficiency for effective comprehension of core curricula.

UNIT I - Basics of Communication **Listening -** Telephone conversation, Listening to Podcast, NEWS, Interviews **Speaking -** Verbal and Non-Verbal Conversation, Role play **Reading -** Types of Reading- Skimming, Scanning, Intensive and Extensive finding key information in a given text **Writing -** Passage Comprehension , Formal Letter Writing Professional Email Writing **Grammar -** Parts of Speech - Noun, Verb, Pronoun & Adverb, Tense -Present Tense, Types of Sentences **Vocabulary -** Prefix & Suffix	**9**
UNIT II - Narrative Skill Development **Listening -** Watching travel documentary **Speaking -** Narrating a story , Narrating a personal incident **Reading -** Reading Travelogues, Blogs **Writing** Paragraph Writing, Rearrangement of jumbled sentences **Grammar -** Tense Past Tense, Subject Verb Agreement, Auxiliary and Modal Verbs **Vocabulary -** Synonyms and Antonyms	**9**
UNIT III Enriching Speaking Skills **Listening -** Dialogues & conversations **Speaking -** Group Conversation, Speaking on given topics and context **Reading -** Reading Newspaper Articles, Reading user manuals **Writing -** Instructions, Writing definitions **Grammar -** Adjective, Tense Future Tense, Types of Questions WH Questions **Vocabulary -** Abbreviations & Acronyms	**9**
UNIT IV - Language Enhancement **Listening -** Listening to TED Talks **Speaking -** Speaking about friends/places/hobbies, Delivering Welcome Address **Reading -** Reading Biography, Reading Editorial **Writing -** Short Report writing **Grammar** Preposition, Question Tags, Yes or No questions, Articles **Vocabulary** One word Substitution	**9**
UNIT V - Technical Usage of Language	**9**

Listening - Listening to native dialects & live commentaries **Speaking -** Group Discussion, Debates, Proposing Vote of Thanks **Reading -** Opinion articles, Journal Reports **Writing -** Essay Writing **Grammar -** Cause and Effect expressions**,** Negations **Vocabulary -** Gerund & infinitives, Compound Noun	
Total Hours	**45**

Textbook(s)	
1	English for Engineers & Technologists Orient Blackswan Private Ltd., Anna University, 2020.
2	Veena Selvam, Sujatha Priyadarshini, Deepa Mary Francis, K. N. Shoba, Lourdes Joevani, English for Science & Technology, Cambridge University Press, 2021.
Reference(s)	
1	English for Academic Correspondence and Socializing by Adrian Wall work, Springer, 2011.
2	Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.
3	Meenakshi Raman, Technical Communication, Oxford University Press, New Delhi, 2017
4	Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai, 2011.

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Communicate effectively using grammatical words according to the context.	K1
CO2	Analyze the given context and frame content accordingly using narrative skills.	K2
CO3	Effectively use language techniques in extended discussions.	K2
CO4	Frame short and long sentences using grammatical techniques according to given context.	K1
CO5	Respond with clarity and accuracy in a range of professional situations, using appropriate linguistic accuracy.	K3

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**3**	**-**	**3**	**-**	**-**	**-**
CO2	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**3**	**-**	**3**	**-**	**-**	**-**
CO3	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**
CO4	**2**	**3**	**2**	**3**	**-**	**3**	**3**	**3**	**2**	**3**	**-**	**3**	**-**	**-**	**-**
CO5	**2**	**3**	**3**	**3**	**-**	**3**	**3**	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

MA24001 – ENGINEERING MATHEMATICS – I								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	1	0	60	4	40	60	100

Course Objectives

- Understand the concept of matrices and reduction quadratic form to canonical form.
- Solve the problems using fundamentals principles of calculus.
- Apply the concept of calculus in several variables.
- To make the students understand various techniques of integration.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals.

UNIT I - MATRICES Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.	**12**
UNIT II – DIFFERENTIAL CALCULUS Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable	**12**
UNIT III - FUNCTIONS OF SEVERAL VARIABLES Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.	**12**
UNIT IV – INTEGRAL CALCULUS Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts(reduction),Trigonometric substitutions, Integration of rational functions by partial fraction,improper intergrals.	**12**
UNIT V - MULTIPLE INTEGRALS Double integrals – Change of order of integration – Double integrals in polar coordinates – Area as a double integral - Triple integrals.	**12**
Total Hours	**60**

Textbook(s)

1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3	James Stewart, "Calculus:Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015.

Reference(s)

1	Anton. H, Bivens. I and Davis. S, " Calculus ", Wiley, 10th Edition, 2016.
2	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd), New Delhi, 7th Edition, 2009.

3	Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4	Narayanan. S. and Manicavachagom Pillai. T. K., "Calculus" Volume I and II, S. Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.
6	Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.
7	Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Understand the matrix algebra methods for solving practical problems.	K2
CO2	Apply differential calculus tools in solving various application problems.	K4
CO3	Use differential calculus ideas on several variable functions.	K3
CO4	Apply different methods of integration in solving problems.	K4
CO5	Apply multiple integral ideas to find the area.	K3

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**
CO2	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**
CO3	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**
CO4	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**
CO5	**3**	**3**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**0**	**2**	**3**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

PH24001 – ENGINEERING PHYSICS

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	0	0	45	3	40	60	100

Course Objectives

- To introduce the concepts of Laser and its applications.
- To achieve an understanding of mechanics.
- To introduce the concepts of thermal physics.
- To gain knowledge about the basics of quantum mechanics.
- To understand the applications of quantum mechanics.

UNIT I – LASER Theory of laser - characteristics - spontaneous and stimulated emission - Laser action- Einstein's A and B coefficients derivation - pumping methods - resonant cavity, optical amplification (qualitative) - population inversion - Types of laser – Nd -YAG laser, CO_2 laser - Basic applications of lasers in industries – laser heat treatment in annealing, welding,	**9**

drilling, cutting and soldering – Application of laser in fibre optic communication system.	
UNIT II - MECHANICS Linear motion and rotational motion – Multi particle dynamics – Center of mass (CM) – kinetic energy of system of particles– Physical significance of moment of inertia – M.I of a diatomic molecule – Torsional pendulum.	**9**
UNIT III - THERMAL PHYSICS Modes of heat transfer - thermal conduction, convection and radiation - heat conduction in solids - thermal conductivity - Lee's disc method: theory and experiment - conduction through compound media (series and parallel) - Application: Solar water heater.	**9**
UNIT IV - BASIC QUANTUM MECHANICS Photons and light waves - wave particle duality - De Broglie's wavelength - Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization - particle in an infinite potential well - particle in a 3D box - correspondence principle (qualitative).	**9**
UNIT V - APPLIED QUANTUM MECHANICS Barrier penetration and quantum tunneling (qualitative)- Scanning Tunneling microscope – Resonant diode – Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model.	**9**
Total Hours	**45**

Textbook(s)	
1	M. N. Avadhanulu, P. G. Kshirsagar, T. V. S. Arun Murthy, "A Textbook of Engineering Physics", 11th Edition, S. Chand & Company Pvt. Ltd., New Delhi, 2019.
2	D. K. Bhattacharya, T. Poonam, "Engineering Physics". Oxford University Press, 2015.
3	R. K. Gaur, S. L. Gupta, "Engineering Physics", Dhanpat Rai Publications, 2013.
4	D.Kleppner and R.Kolenkow. An Introduction to Mechanics. McGraw Hill Education (Indian Edition), 2017
Reference(s)	
1	R. Wolfson, "Essential University Physics", Volume 1 & 2. Pearson Education (Indian Edition), 2009.
2	D. Halliday, R. Resnick, J. Walker, "Principles of Physics", Wiley Publishers (Indian Edition), 2015.
3	Dattu R Joshi, "Engineering Physics", 1st Edition, Tata McGraw Hill Publications, New Delhi, 2010.
4	B. K. Pandey, S. Chaturvedi, "Engineering Physics", Cengage Learning India, 2017.
5	Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", McGraw Hill (Indian Edition), 2017.

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Gain knowledge about lasers and its applications.	K2
CO2	Understand the importance of mechanics.	K1
CO3	Acquire knowledge on the concepts of thermal physics.	K2

CO4	Understand the concepts of quantum mechanics.	K1
CO5	Comprehend and express their knowledge about applications of quantum mechanics.	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**2**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**3**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO4	**3**	**3**	**1**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**3**	**1**	**1**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

CY24002 – CHEMISTRY FOR LIFE SCIENCES								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	0	0	45	3	40	60	100

Course Objective

- To help the learners, analyze the hardness of water and its removal.
- To endow an overview of solutions and its applications.
- To rationalize the significance of chemical kinetics and catalysis.
- To appreciate the need for and importance of Polymer materials and Heterocyclic compounds.
- To enhance the knowledge in line with the modern techniques for material analysis.

UNIT I – WATER TECHNOLOGY Introduction – Commercial and industrial uses of water - hardness - types – estimation of hardness by EDTA method- Internal conditioning (colloidal, phosphate, calgon and carbonate conditioning methods) – external conditioning (Zeolite process, demineralization process) - Desalination methods (Reverse Osmosis and Electro dialysis). Flash evaporation.	**7**
UNIT II – SOLUTIONS Normality, molarity, molality, percentage solution, mole fractions (simple numerical problems). Buffer solutions – types – applications- Henderson-Hasselbach equation. Membrane permeability - Principle of diffusion & osmosis - Donon membrane equilibrium. Definition of osmotic pressure, isotonic, hypotonic & hypertonic solutions. Relationship of osmotic pressure to gas laws. The general equation for dilute solutions, the influence of ionization & molecular size on osmotic pressure. Biological importance of osmosis. Colloids - Definition and Types, Gold Number, Preparation and Properties of colloids – lyophilic and lyophobic sols. Brownian movements and Tyndall Effect. Emulsion & emulsifying agents.	**10**
UNIT – III CHEMICAL KINETICS AND CATALYSIS Rate of reaction, order and molecularity-– derivation of first order rate equation – half-life period of First order reaction – determination of rate constant of hydrolysis of ester - factors influencing rate of reaction – activation energy -Arrhenius equation –Transition state theory-	**10**

Catalyst– Auto catalyst – Enzyme catalyst – Michaelis–Menten equation and its significance. Catalytic Promoters – Catalytic poisons – Active center, homogeneous and heterogeneous catalysis – Reactivity – Coenzymes – Proton transfer – metal ions – Intra molecular reactions – Covalent catalysis – Inclusion complexation - Industrial application of catalysts.	
UNIT – IV ELECTROCHEMISTRY Terminology involved in electrochemistry – Types of Cells - Galvanic and concentration cells- Derivation of Nernst equation - Applications of Electrochemical series - Types of Electrodes - Hydrogen, Calomel, ion-selective electrode - Determination of pH using glass electrode - Determination of electrode potentials - Conductometric titrations - Potentiometric titration-Redox titration.	**9**
UNIT – V ANALYTICAL TECHNIQUES Electromagnetic spectrum - absorption of radiation - electronic, vibrational and rotational transitions - Thermal methods of analysis - TGA, DTA – Principle, instrumentation and applications - Spectro Analytical methods - Colorimetry, IR, UV-visible spectroscopy - Principles instrumentation and applications.	**9**
Total Hours	**45**

Textbook(s)	
1	O.G. Palanna "Engineering Chemistry" Tata McGraw-Hill Pub.Co.Ltd, New Delhi, 2017.
2	P.C. Jain and Monica Jain, A Textbook of Engineering Chemistry, DhanpatRai publications, New Delhi, 16th edition, 2015.
3	Shikha Agarwal "Engineering Chemistry-Fundamentals and applications", Cambridge University Press, New Delhi, 2015.
Reference(s)	
1	Peter Grundler "Chemical Sensors" ISBN 978-3-540-45742-8 Springer Berlin Heidelberg New York, 2007.
2	B. R. Puri, L.R. Sharma, and S. P. Madan. Principles of Physical Chemistry: Vishal Publishing Company. Gumber Market, Old Railway Road, Jalandhar.
3	Upadhyay, A.; Upadhyay, K.; Nath, N. Biophysical chemistry: Principles and Techniques; Himalaya Publishing House, Bombay.,1993.

On the successful completion of the course, students will be able to

Course Outcome		**Level**
CO1	Identify the types of hardness of water and its removal.	K1
CO2	Understand the concept of solutions.	K2
CO3	Interpret the kinetics of the reaction and its significance.	K3
CO4	Recognize the need of advanced polymer and heterocyclic compounds in industrial applications.	K3
CO5	Identify the structure of unknown/new compounds with the help of spectroscopy.	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3				3		3	3		3	3	3
CO2	3	3	3				3		3	3		3	3	3
CO3	3	3	3				3		3	3		3	3	3
CO4	3	3	3				2		2	2		3	3	2
CO5	3	3	3				3		3	3		3	3	3
3 – Strong, 2 – Medium, 1 - Low														

ES24001 – ENGINEERING GRAPHICS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	2	0	4	60	4	40	60	100

Course Objectives

- Drawing engineering curves and free hand sketch of simple objects.
- Drawing orthographic projection of points, lines and plane surface.
- Drawing orthographic projection of solids.
- Drawing development of solids and section of solids.
- Drawing isometric and perspective projections of simple solids.

CONCETPS AND CONVENTIONS (Not for Examination) Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning. **UNIT I - PLANE CURVES AND FREE HAND SKETCHING** Basic Geometrical constructions, Curves used in engineering practices: Conics - Construction of ellipse, parabola and hyperbola by eccentricity method - Construction of cycloid - construction of involutes of square and circle - Drawing of tangents and normal to the above curves.	**12**
UNIT II - PROJECTION OF POINTS, LINES AND PLANE SURFACE Orthographic projection – principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only first angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces. Projection of Planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.	**12**
UNIT III - PROJECTION OF SOLIDS Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes and parallel to the other by rotating object method and auxiliary plane method.	**12**
UNIT IV - PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF	**12**

SURFACES Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other-obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids-Prisms, Pyramids cylinders and cones.	
UNIT V - ISOMETRIC AND PERSPECTIVE PROJECTIONS Principles of isometric projection - isometric scale - Isometric projections of simple solids and truncated solids- Prisms, Pyramids cylinders and cones. Combination of two solid objects vertical positions. Perspective projection of simple solids- Prisms, Pyramids and cylinders by visual ray method. Computer assisted isometric and perspective projections.	**12**
Total Hours	**60**

Textbook(s)	
1	N. D. Bhatt,V. M. Panchal, "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2019.
2	K. V. Natrajan,"A Text Book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.
3	N. S. Parthasarathy, Vela Murali, "Engineering Drawing", Oxford University Press, 2015.
Reference(s)	
1	Basant Agarwal,C. M. Agarwal, "Engineering Drawing", McGraw Hill, 2ndEdition, 2019.
2	K. R. Gopalakrishna, "Engineering Drawing" (Vol.I & II combined), 27th Edition, Subhas Publications, Bangalore, 2017.
3	J. Luzzader, Warren,M. Duff, John, "Fundamentals of Engineering Drawing with an Introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4	N. S. Parthasarathy, Vela Murali, "Engineering Graphics", Oxford University, Press, New Delhi, 2015.
5	M. B. Shah, B. C. Rana, "Engineering Drawing", 2ndEdition, Pearson Education India, 2009.
6	K. Venugopal,V. Prabhu Raja, "Engineering Graphics", New Age International (P) Ltd, 2008.

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Familiarize with the fundamentals and standards of engineering drawing. Construct the conic curves, in volutes and cycloid, and perform free hand sketching of basic geometrical constructions and multiple views of objects.	K3
CO2	Draw the orthographic projections of points, lines and plane surfaces.	K4
CO3	Draw the projection of simple solids.	K3
CO4	Draw the projection of sectioned solids and draw the development of surfaces of simple solids.	K3
CO5	Visualize and projections of Isometric and perspective projections of simple solids.	K5

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**

CO2	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**
CO3	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**
CO4	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**
CO5	**3**	**1**	**2**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**-**	**2**	**2**	**2**	**-**
3 – Strong, 2 – Medium, 1 – Low															

TA24001 – HERITAGE OF TAMILS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	1	0	0	15	1	40	60	100

Course Objectives

- To learn the extensive literature of classical tamil.
- To review the fine arts heritage of tamil culture.
- To realize the contribution in Indian freedom struggle.
- To understand the role of Temple in Sangam cities/ports, Chola conquest.
- To examine Tamil cultural influence in India.

UNIT I - 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.	**3**
UNIT II - 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.	**3**
UNIT III - FOLK AND MARTIAL ARTS Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.	**3**
UNIT IV - 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.	**3**
UNIT V - 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 Inscriptions & Manuscripts.	**3**
Total Hours	**15**

Textbook(s)

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).
Reference(s)	
1	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL (in print).
2	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies
3	Historical Heritage of the Tamils (Dr. S. V. Subramanian, Dr. K. D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).
5	Keeladi - 'Sangam City Civilization on the banks of River Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author).
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
8	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Remember the extensive literature of tamil and its classical nature, musical instruments, Folk, Thinai concept, Indian Freedom Struggle & Aham, Puram and Aram Concept.	K1
CO2	Remember the principles in Thirukural, Bakthi Literature Azhwars and Nayanmars, heritage of sculpture, painting ancient people.	K1
CO3	Understand on folk and martial arts of tamil people, Justice in Sangam Literature, Development of Modern literature in Tamil, Making of musical instruments.	K2
CO4	Understand the Ancient Cities and Ports of Sangam Age of Tamils	K2
CO5	Understand the Cultural Influence of Tamils over the other parts of India, contribution of Tamils self-esteem movement.	K1

Mapping with Program Outcomes

Cos	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	-	-	-	-	-	-	**3**	**3**	-	**3**	-	**3**	-	-	-
CO2	-	-	-	-	-	-	**3**	**3**	-	**3**	-	**3**	-	-	-
CO3	-	-	-	-	-	-	**3**	**3**	-	**3**	-	**3**	-	-	-
CO4	-	-	-	-	-	-	**3**	**3**	-	**3**	-	**3**	-	-	-
CO5	-	-	-	-	-	-	**3**	**3**	-	**3**	-	**3**	-	-	-
3 – Strong, 2 – Medium, 1 – Low															

TA24001 – தமிழர் மரபு								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ES	Total
I	1	0	0	15	1	40	60	100

Course Objectives

- விரிவான இலக்கியம் மற்றும் செம்மொழி தமிழ் கற்க.
- தமிழ் கலாச்சாரத்தின் நுண்கலை பாரம்பரியத்தை மதிப்பாய்வு செய்ய.
- இந்திய சுதந்திரப் போராட்டத்தில் பங்களிப்பை உணர வேண்டும்.
- சங்க நகரங்கள்/துறைமுகங்களில் கோயிலின் பங்கைப் புரிந்து கொள்ள, சோழர்களின் வெற்றி.
- இந்தியாவில் தமிழ் கலாச்சார தாக்கத்தை ஆய்வு செய்ய.

அலகு I - மொழி மற்றும் இலக்கியம் இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை திருக்குறளில் மேலாண்மைக் கருத்துக்கள் தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் -பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் சிற்றிலக்கியங்கள் தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி.	**3**
அலகு II - மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை - சிற்பக் கலை நடுகல் முதல் நவீன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை - நாட்டுப்புறத் தெய்வங்கள் குமரிமுனையில் திருவள்ளுவர் சிலை .	**3**
அலகு III - நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள் தெருக்கூத்து கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து. ஒயிலாட்டம் தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.	**3**
அலகு IV - தமிழர்களின் திணைக் கோட்பாடுகள் தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும்.	**3**
அலகு V - இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுயமரியாதை இயக்கம், கையெழுத்துப்படிகள்.	**3**
Total Hours	**15**

Textbook(s)

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).
Reference(s)	
1	Social Life of Tamils (Dr. K. K. Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
2	Social Life of the Tamils - The Classical Period (Dr. S. Singaravelu) (Published by: International Institute of Tamil Studies).
3	Historical Heritage of the Tamils (Dr. S.V. Subramanian, Dr. K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
4	The Contributions of the Tamils to Indian Culture (Dr. M. Valarmathi) (Published by: International Institute of Tamil Studies).
5	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu).
6	Studies in the History of India with Special Reference to Tamil Nadu (Dr. K. K. Pillay) (Published by: The Author).
7	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
8	Journey of Civilization Indus to Vaigai (R. Balakrishnan) (Published by: RMRL).

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Remember the extensive literature of tamil and its classical nature, musical instruments, Folk, Thinai concept, Indian Freedom Struggle & Aham, Puram and Aram Concept.	K1
CO2	Remember the principles in Thirukural, Bakthi Literature Azhwars and Nayanmars, heritage of sculpture, painting of ancient people.	K1
CO3	Understand on folk and martial arts of tamil people, Justice in Sangam Literature, Development of Modern literature in Tamil, Making of musical instruments.	K2
CO4	Understand the Ancient Cities and Ports of Sangam Age of Tamils	K2
CO5	Understand the Cultural Influence of Tamils over the other parts of India, contribution of Tamils self-esteem movement.	K1

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	-	3	3	-	3	-	3	-	-	-
CO2	-	-	-	-	-	-	3	3	-	3	-	3	-	-	-
CO3	-	-	-	-	-	-	3	3	-	3	-	3	-	-	-
CO4	-	-	-	-	-	-	3	3	-	3	-	3	-	-	-
CO5	-	-	-	-	-	-	3	3	-	3	-	3	-	-	-
3 – Strong, 2 – Medium, 1 – Low															

MN24001 – OVERVIEW OF ENGINEERING AND TECHNOLOGY

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	0	0	45	0	100	-	100

Course Objectives

- To outline the basics of the Civil Engineering.
- To learn the fundamentals of Mechanical Engineering.
- To impart knowledge on fundamental concepts and recent trends in the field of Electrical and Control Systems.
- To provide the overview of the Computer Science and Engineering and AI&DS.
- To provide the overview of Food Technology and Bio Medical Engineering.

UNIT I – INTRODUCTION TO ENGINEERING & TECHNOLOGY Science, Engineering and Technology(E&T), Approaches for a Scientific process vs an Engineering process; Engineering Product Life Cycle, processes in Engineering Design Methodology with few examples; various branches in Engineering and Technology (Traditional and Recent), Impact of E&T on human life, (pros & cons); Activities performed by an Engineer, Interdisciplinary nature of real world problems; Revised Bloom's Taxonomy Levels (BTL)	**9**
UNIT II – OVERVIEW OF CIVIL, MECHANICAL AND AGRICULTURAL ENGINEERING Introduction - Who is a civil Engineer? -Roles and Responsibilities- Scope and Opportunities- Structures -Geo Technical Engineering - Estimation and Costing- Construction - Project Management - Structural Engineering - Irrigation and Water Supply. Introduction - Who is a Mechanical Engineer? - Roles and Responsibilities - Scope and Opportunities – Manufacturing- Design - Automobile-Power Generation - Industrial Engineering- computer aided design and manufacturing - computer integrated manufacturing. Introduction - Who is an Agricultural Engineer? - Difference between Agricultural & Horticultural Engineering - Types of Agricultural Engineering - Processing or Post Harvest Engineering - Farm Power and Machinery Engineering - Soil and Water Conservation Engineering - Environmental Control Engineering - Forestry - Wood Product Engineering - Food Engineering - Scope and Opportunities.	**9**

UNIT III – OVERVIEW OF ELECTRICAL, ELECTRONICS AND COMMUNICATION ENGINEERING Introduction- Different between Electrical Engineer and Electronics Engineer - Roles and Responsibilities - Scope and Opportunities - Power Generation and Consumption - Reason development - Current area of research - Energy audit - Energy utilization -PLC- Embedded control systems and computer based control system- wired and wireless communication- satellite communication- IoT communication network.	**9**
UNIT IV - OVERVIEWOF COMPUTER SCIENCE AND ENGINEERING, CYBER SECURITY & AI &DS Introduction- Different between Computer Science and Engineering and AI&DS - Job Description-Roles and Responsibilities - Scope and Opportunities.Computer hardware and software - programming languages, operating system - application of software-database management system (DBMS) - Computer networks - Internet and computer security- Web technology - Mobile application - Artificial intelligent (AI) - Machine learning(ML) - Internet of things(IoT) - Black chain - Cyber security -Cloud computing.	**9**
UNIT V –OVERVIEW OF FOOD TECHNOLOGY AND BIO MEDICAL ENGINEERING Introduction - Scope and Importance of Food Technology - Historical development and trends in the field - Sources of food - Chemical composition of food - Microorganisms in food - Food borne illness and safety measures - Unit operations in food Processing - Principles and methods of Food Processing - Case studies on successful food products or processes. Introduction-Role of Biomedical Engineer - Scope of Biomedical Engineer- Key Areas: Bio materials, Biomechanics, Biomedical Instrumentation, Medical Devices, Clinical Engineering, Cell and Tissue Engineering-Career Opportunities:Research and Development- Applications and Future Directions.	**9**
Total Hours	**45**

Textbook(s)	
1	"Overview of Engineering and Technology", Lecture Notes from DSCE, 2024.
2	"Introduction to Engineering Technology and Engineering" by Val D Hawks, A Brent Strong, 1st Edition, Pearson Publisher, 2000.
Reference(s)	
1	N. R. Banapurmath,V. S. Yalliwal, "Basics of Mechanical Engineering",Vikas Publishing House, 2021.
2	G. Shanmugam, M. S. Palanichamy, "Basic Civil and Mechanical Engineering", McGraw Hill Education; 1st Edition, 2018.
3	D. P. Kothari, I.J. Nagrath, "Basic Electrical Engineering", 4th Edition, McGraw Hill Education, 2019.
4	Albert Malvino, David J. Bates," Electronic Principles (SIE)", 7th Education, McGraw Hill 2017.
5	Reema Thareja, "Fundamentals of Computer", Oxford University Press, 2016.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Identify the major areas and relate their current trends in Civil Engineering.	K1
CO2	Explain the principles behind various mechanical systems and components.	K2
CO3	Identify different Electricals and Control Systems applied in the Engineering field.	K3
CO4	Relate the various Electronics and Communication Systems involved in real life.	K4
CO5	Understand the components of computer hardware, software, and operating systems and their applications in real life.	K2

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**2**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**-**	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**1**	**-**	**-**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 - Low															

BS24001 – ENGINEERING PHYSICS AND CHEMISTRY LABORATORY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	0	0	4	60	2	60	40	100

ENGINEERING PHYSICS LABORATORY

Course Objectives

- To acquaint the students with practical knowledge of physics principles in various fields such as optics, thermal physics and properties of matter for developing basic experimental skills.
- To learn the proper use of various kinds of physics laboratory equipment.
- To learn how data can be collected, presented and interpreted in a clear and concise manner.
- To determine error in experimental measurements and techniques used to minimize such errors.
- To make the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS (Any 7 Experiments)

1. Determination of rigidity modulus of a metallic wire using torsional pendulum.
2. Determination of Young's modulus – Non-uniform bending method.
3. Determination of Young's modulus – Uniform bending method.
4. Determination of Young's modulus – Cantilever method.
5. Determination of wavelength of the laser using grating.
6. a) Determination of Acceptance angle and Numerical aperture of an optical fiber.
   b) Determination of width of the groove using laser.
7. Determination of thickness of a thin film by air-wedge arrangement.

8. Determination of velocity of sound and compressibility of liquid using Ultrasonic Interferometer.	
9. Determination of velocity of ultrasonic waves using acoustic grating.	
10. Determination of the band gap of a given semiconducting material.	
11. Determination of Planck's constant and work function using Photoelectric effect.	
12. Determination of frequency of the vibrator using Melde's string arrangement.	
Total Hours	**30**

Reference(s)

1	M. N. Srinivasan, S. Balasubramanian, R. Ranganathan, "Practical Physics", S. Chand & Sons Educational Publications, New Delhi, 2011.
2	P. R Sasikumar, "Practical Physics", PHI Learning Pvt. Ltd., New Delhi, 2011.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Upon completion of the course, the students will be able to apply principles of elasticity, optics and thermal properties for engineering applications.	K1
CO2	Use graphical models to analyze laboratory data.	K2
CO3	Use mathematical models as a medium for quantitative reasoning and describing physical reality.	K2
CO4	Access, process and analyze scientific information.	K3
CO5	Solve problems individually and collaboratively	K3

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO2	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO3	**3**	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**3**	**3**	**2**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**3**	**2**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

ENGINEERING CHEMISTRY LABORATORY

Course Objectives

- To make the students to acquire practical skills in basic understanding of water quality parameters such as, hardness, alkalinity, acidity, DO, chloride and copper content.
- To induce the students to familiarize with electro analytical techniques such as, conductometry, potentiometry and pH metry.
- To demonstrate the synthesis of nano particles.
- To develop skills on analysis of coal.

LIST OF EXPERIMENTS: (Any 7 Experiments)	

1. Estimation of acidity of a water sample using the primary standard.	
2. Determination of types and amount of alkalinity in water sample.	
3. Determination of total, temporary & permanent hardness of water by EDTA method.	
4. Determination of DO content of water sample by Winkler's method.	
5. Determination of chloride content of water sample by Argentometric method.	
6. Estimation of copper content of the given solution by Iodometry.	
7. Estimation of TDS of a water sample by gravimetry.	
8. Determination of strength of strong acid using conductivity meter.	
9. Determination of strength of acids in a mixture of acids using conductivity meter.	
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)	
11. Determination of strength of given hydrochloric acid using pH meter.	
12. Estimation of iron content of the given solution using potentiometer.	
13. Estimation of sodium/potassium present in water using flame photometer.	
14. Preparation of nano particles (TiO_2/ZnO/CuO) by Sol-Gel method.	
15. Proximate analysis of Coal	
Total Hours	**30**

Reference(s)	
1	J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar, "Vogel's Text Book of Quantitative Chemical Analysis", (2009).
2	G. H. Jeffery, J. Bassett, J. Mendham, R. C. Denney, "Vogel's Text Book of Quantitative Chemical Analysis, 5th Edition, 2009.

On the successful completion of the course, students will be able to

Course Outcomes		**Level**
CO1	Analyze the quality of water samples with respect to their hardness, alkalinity, acidity and DO.	K4
CO2	Determine the amount of metal ions through volumetric and spectroscopic techniques.	K4
CO3	Analyze and determine the composition of coals.	K3
CO4	Learn simple method of synthesis of nano particles.	K1
CO5	Quantitatively analyze the impurities in solution by electro analytical techniques.	K2

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**3**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO2	**3**	**1**	**2**	**-**	**-**	**1**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
CO3	**3**	**2**	**1**	**1**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO4	**2**	**1**	**2**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
CO5	**2**	**1**	**2**	**-**	**1**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

ES24002 – ENGINEERING PRACTICES LABORATORY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	0	0	4	60	2	60	40	100

Course Objectives

- Prepare pipe line plan; laying and connecting various pipe fittings used in common household plumbing work. Making joints in wood materials used in common household wood work.
- Prepare various welding joints in steel plates using arc welding work
- Wiring various electrical joints in common household electrical wire work.
- Welding various joints in steel plates using arc welding work; Machining various simple processes like turning, drilling, tapping in parts; Assembling simple mechanical assembly of common household equipments; Making a tray out of metal sheet using sheet metal work.
- Soldering and testing simple electronic circuits; Assembling and testing simple electronic components on PCB.

CIVIL ENGINEERING PRACTICES:

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing
- Planning
- Making joints like T-Joint, Mortise joint and Tenon joint and Dovetail joint.

WOOD WORK STUDY:

- Studying joints indoor panels and wooden furniture.
- Studying common industrial trusses using models.

ELECTRICAL ENGINEERING PRACTICES :

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and Electronic type using

Diac/Triac/quadrac) • Study of emergency lamp wiring/Water heater	
MECHANICAL ENGINEERING PRACTICES :	
WELDING WORK: • Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. • Practicing gas welding • Making of models.	
BASIC MACHINING WORK: • (simple) Turning. • (simple) Drilling. • (simple) Tapping.	
SHEET METAL WORK: • Making of as square tray.	
FOUNDRY WORK: • Demonstrating basic foundry operations.	
ELECTRONIC ENGINEERING PRACTICES:	
SOLDERING WORK: • Soldering simple electronic circuits and checking continuity	
ELECTRONIC ASSEMBLY AND TESTING WORK: • Assembling and testing electronic components on a small PCB.	
ELECTRONIC EQUIPMENT STUDY: • Study elements of smart phone. • Study of TV parts and working. • Assembly and dismantle of computer/ laptop	
Total Hours	**60**
Reference(s)	
1.	Shoop, Charles Franklin, "Mechanical Engineering Practice: A Laboratory reference text", McGraw-Hill Publisher, 1956.
2.	S Gowri, T Jayapoovan, "Engineering Practices Lab Manual", Vikas Publishing House, 2011.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Draw pipe line plan; layout and connect various pipe fittings used in common household plumbing work; make joints in wood materials used in common household wood work.	K1
CO2	Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assembles simple mechanical common household equipments; Make a tray out of metal sheet using sheet metal work.	K2
CO3	Wire various electrical joints in common household electrical wire work.	K2
CO4	Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.	K2

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO2	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO3	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO4	**3**	**2**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**2**	**1**	**1**
CO5	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

HS24002– COMMUNICATIVE LABORATORY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	0	0	2	30	1	60	40	100

Course Objectives

- To enable learners to understand the basics of communication.
- To empower learners to use narrative techniques to convey ideas and experiences in academic and work environment.
- To support learners in enhancing their linguistic competence and engaging in effortless dialogue.
- To assist learners in mastering language for the successful academic and professional communication.
- To strengthen language proficiency for effective comprehension of core curricula.

Basics of Communication **Listening -** Telephone conversation, Listening to Podcast, NEWS, Interviews **Speaking -** Verbal and Non-Verbal Conversation, Role play **Reading -** Types of Reading- Skimming, Scanning, Intensive and Extensive - finding key information in a given text	**6**
Narrative Skill Development **Listening -** Watching travel documentary **Speaking -** Narrating a story -Narrating a personal incident **Reading -** Reading Travelogues, Blogs	**6**
Enriching Speaking Skills **Listening -**Dialogues & Conversations **Speaking -**Group Conversation, Speaking on given topics and context **Reading -** Reading Newspaper Articles, Reading user manuals	**6**
Language Enhancement **Listening -** Listening to TED Talks, **Speaking -** Speaking about friends/places/hobbies, Delivering Welcome Address **Reading -** Reading Biography, Reading Editorial.	**6**
Technical Usage of Language	**6**

Listening - Listening to native dialects & live commentaries **Speaking -** Group Discussion, Debates, Proposing Vote of Thanks **Reading -** Opinion articles, Journal Reports	
Total Hours	**30**
Reference(s)	
1	English for Academic Correspondence and Socializing by Adrian Wall work, Springer, 2011.
2	Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw-Hill India, 2017.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Communicate effectively using grammatical words according to the context.	K3
CO2	Analyze the given context and frame content accordingly using narrative skills.	K4
CO3	Effectively use language techniques in extended discussions.	K3
CO4	Frame short and long sentences using grammatical techniques according to given context.	K3
CO5	Respond with clarity and accuracy in a range of professional situations, using appropriate linguistic accuracy.	K4

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
CO2	**2**	**3**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
CO3	**2**	**2**	**3**	**3**	**1**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
CO4	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
CO5	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**
3 - Strong, 2 - Medium, 1 – Low															

CO5	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

HS24003 - COMMUNICATIVE ENGLISH II								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
II	3	0	0	45	3	40	60	100

Course Objectives

To enable the students to:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations, participate in group discussions.
- Strengthen their listening skill which will help them comprehend lectures and talks in their areas of specialization.
- Explore the business communication knowledge and understand the importance of presentation.

UNIT I - INTRODUCTION TO TECHNICAL ENGLISH **Listening** - Listening to talks mostly of a scientific/technical nature and completing information-gap exercises **Speaking** - Asking for and giving directions **Reading** - reading short technical texts from journals- news papers **Writing** - purpose statements – extended definitions – writing instructions – checklists-recommendations **Language Development** - subject verb agreement - compound words	**9**
UNIT II - READING AND STUDY SKILLS **Listening** - Listening to longer technical talks and completing exercises based on them- **Speaking** – Describing a process **Reading** – Reading longer technical texts- identifying the various transitions in a text-paragraphing **Writing** - Interpreting charts, graphs **Vocabulary Development**-vocabulary used in formal letters/emails and reports **Language Development** - Impersonal passive voice, numerical adjectives.	**9**
UNIT III – TECHNICAL WRITING AND GRAMMAR **Listening** - Listening to classroom lectures/ talks on engineering/technology **Speaking** - Introduction to technical presentations **Reading** – longer texts both general and technical, practice in speed reading; **Writing** - Describing a process, use of sequence words **Vocabulary Development** - sequence words- Misspelled words. **Language Development** - embedded sentences.	**9**
UNIT IV - PROFESSIONAL WRITING **Listening** - Listening to documentaries and making notes. **Speaking** – mechanics of presentations **Reading** – reading for detailed comprehension **Writing** - email etiquette - job application – cover letter – Resume preparation (digital and paper based) – analytical essays and issue based essays **Vocabulary Development** - finding suitable synonyms-paraphrasing	**9**

Language Development - clauses- if conditionals.	
UNIT V - BUSINESS COMMUNICATION **Listening** - TED/Ink talks **Speaking** – participating in a group discussion **Reading** – reading and understanding technical articles **Writing** – Writing reports - accident and survey report – Memos – Notices - Circulars - Minutes of a meeting **Vocabulary Development**- verbal analogies- reported speech.	**9**
Total Hours	**45**

Textbook(s)	
1	Swan Michael- Practical English Usage-Oxford University Press.
2	Thomas A.J. and Martinet A.V- A Practical English Language-Oxford
Reference(s)	
1	Raman, Meenakshi and Sharma, Sangeetha- Technical Communication Principles and Practice. Oxford University Press: New Delhi, 2014.
2	Kumar, Suresh. E. Engineering English. Orient Blackswan: Hyderabad, 2015.
3	Booth-L. Diana, Project Work, Oxford University Press, Oxford: 2014.
4	Grussendorf, Marion, English for Presentations, Oxford University Press, Oxford: 2007.
5	Means, L. Thomas and Elaine Langlois, English & Communication For Colleges. Cengage Learning, USA: 2007.
6	Troyka& Hesse – Handbook for writers- Pearson Publication, 11th edition, 2017.

On the successful completion of the course, students will be able to

Course Outcome		**Level**
CO1	Use proper technical vocabulary and grammar in appropriate contexts.	K2
CO2	Enhance speaking skills to participate confidently in formal / informal conversations and to do effective Presentations/Discussions.	K1
CO3	Critically read and analyze technical texts and articles of a general kind.	K1
CO4	Acquire a working knowledge of writing strategies, formats and templates of professional writing.	K3
CO5	Analyze different way of communication and get familiarized with proper presentation.	K2

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1	1	2	2	-	-	2	3	3	3	-	-	-
CO2	-	1	1	1	1	-	1	2	2	3	3	3	-	-	-
CO3	1	1	-	1	2	1	1	-	2	3	3	3	-	-	-
CO4	-	1	1	1	1	1	-	1	2	3	3	3	-	-	-
CO5	-	-	1	1	1	1	1	1	3	3	3	3	-	-	-
3 – Strong, 2 – Medium, 1 – Low															

MA24002 – STATISTICS AND NUMERICAL METHODS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
II	3	1	0	60	4	40	60	100

Course Objective

- This course aims at providing the necessary basic concepts of a few statistical and numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of solving algebraic and transcendental equations.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
- To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I NON- PARAMETRIC TESTS Introduction - The Sign test - The Signed - Rank test - Rank - sum tests - The U test - The H test - Tests based on Runs - Test of randomness - The Kolmogorov Tests.	**9+3**
UNIT II - DESIGN OF EXPERIMENTS One way and two way classifications - Completely randomized design – Randomized block design – Latin square design**.**	**9+3**
UNIT III - SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS Solution of algebraic and transcendental equations - Fixed point iteration method – Newton Raphson method- Solution of linear system of equations - Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel – Eigen values of a matrix by Power method and Jacobi's method for symmetric matrices.	**9+3**
UNIT IV - INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	**9+3**

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single integrations using Trapezoidal and Simpson's 1/3 rules.	
UNIT V - NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS Single step methods: Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge - Kutta method for solving first order differential equations - Multi step methods: Milne's and Adams - Bash forth predictor corrector methods for solving first order differential equations.	**9+3**
Total Hours	**60**

Textbook(s)	
1	Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10th Edition, New Delhi, 2015.
2	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
Reference(s)	
1	Burden, R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3	Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4	Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
5	Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics ", Tata McGraw Hill Edition, 4th Edition, 2012.
6	Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", 9th Edition, Pearson Education, Asia, 2010.

On the successful completion of the course, students will be able to

Course Outcome		**Level**
CO1	Upon successful completion of the course, students will be able to: Apply the concept of testing of hypothesis for small and large samples in real life problems.	K1
CO2	Apply the basic concepts of classifications of design of experiments in the field of agriculture.	K4
CO3	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	K2
CO4	Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.	K3
CO5	Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.	K2

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO2	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO3	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO4	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-
CO5	3	3	1	1	1	-	-	-	2	-	2	3	-	-	-

3 – Strong, 2 – Medium, 1 – Low

EE24003 -BASIC ELECTRICAL AND ELECTRONICS ENGINEERING							
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ES	Total
II	3	0	0	45	3	40	60	100

Course Objective

- To introduce the basics of electric circuits and analysis
- To impart knowledge in the basics of working principles and application of electrical machines
- To introduce analog devices and their characteristics
- To educate on the fundamental concepts of digital electronics
- To introduce the functional elements and working of measuring instruments

UNIT 1 ELECTRICAL CIRCUITS DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws –Independent and Dependent Sources – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state).Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – Steady state analysis of RLC circuits (Simple problems only).	**9**
UNIT II ELECTRICAL MACHINES Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Three phase Alternator, Synchronous motor and Three Phase Induction Motor.	**9**
UNIT III ANALOG ELECTRONICS Semiconductor Materials: Silicon & Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications -MOSFET, I-V Characteristics and Applications, Operational amplifier and its applications.IC-555 timer, Astable multivibrator.	**9**
UNIT IV DIGITAL ELECTRONICS Review of number systems, binary codes, error detection and correction codes, representation of logic functions-SOP and POS forms, adder and subtractor - minimization using K maps (Simple Problems only), Combinational logic circuits.	**9**

UNIT V - MEASUREMENTS AND INSTRUMENTATION Functional Functional elements of an instrument, Standards and calibration, Operating Principle, types -Moving Coil and Moving Iron meters, Measurement of three phase power, Energy Meter, Instrument Transformers-CT and PT, DSO- Block diagram- Data acquisition system..	**9**
Total Hours	**45**

Textbook(s)	
1	Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", Second Edition, McGraw Hill Education, 2020
2	S.K. Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
3	Sedha R.S., "A text book book of Applied Electronics", S. Chand & Co., 2008
4	James A. Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
Reference(s)	
1	Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2	Thomas L. Floyd, 'Digital Fundamentals', 11thEdition, Pearson Education, 2017.
3	Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7thedition, 2017.
4	Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, 2002.
5	H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010
6	Muthusubramaniam R, Salivahanan S, "Basic Electrical and Electronics Engineering", Tata Mc Graw Hill P ublishers, 2018

On the successful completion of the course, students will be able to

Course Outcome- After completing this course, the students will be able to		**Level**
CO1	Compute the electric circuit parameters for simple problems	K2
CO2	Explain the working principle and applications of electrical machines	K2
CO3	Analyze the characteristics of analog electronic devices	K1
CO4	Explain the basic concepts of digital electronics	K2
CO5	Explain the operating principles of measuring instruments	K3

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO2	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO3	2	1	1	-	-	-	-	1	-	-	-	2	-	-	1

CO4	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
CO5	2	2	1	-	-	-	-	1	-	-	-	2	-	-	1
3 – Strong, 2 – Medium, 1 – Low															

CS24001– PROBLEM SOLVING AND PYTHON PROGRAMMING								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
I	3	1	0	60	4	40	60	100

Course Objectives

- To understand the basics of algorithmic problem solving.
- To learn to solve problems using Python conditionals and loops.
- To define Python functions and use function calls to solve problems.
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To do input/output with files in Python.

UNIT I INTRODUCTION TO PROBLEM SOLVING Fundamentals of Computing, Identification of computational problems, Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).	**12**
UNIT II BASICS OF PYTHON PROGRAMMING Introduction: Features, Installation, Modes of operations (interpreter and interactive mode); variables and data types: int, float, boolean, string, and list; expressions, statements, operators and comments; modules and functions.	**12**
UNIT III CONTROL STATEMENTS & FUNCTIONS Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values,parameters, local and global scope, function composition, recursion.	**12**
UNIT IV SEQUENTIAL DATA TYPES Strings: String slices, String functions and methods, immutability; Lists: list operations, list slices, list methods, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension.	**12**
UNIT V FILES HANDLING AND EXCEPTIONS Files Handling: File types and operations (open, close, read and write), file positions; command line arguments; Exceptions : Introduction to errors and exceptions, handling exceptions, modules, packages.	**12**
Total Hours	**60**
Textbook(s)	

1	Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2	Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.
Reference(s)	
1	Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2	G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3	John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021.
4	Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.
5	Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Develop algorithmic solutions to simple computational problems.	K3
CO2	Develop and execute simple Python programs.	K3
CO3	Write simple Python programs using conditionals and loops for solving problems.	K2
CO4	Represent compound data using Python lists, tuples, dictionaries etc.	K2
CO5	Read and write data from/to files in Python programs.	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**3**	**-**
CO2	**3**	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**2**	**3**	**-**	**-**
CO3	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**3**	**-**	**-**
CO4	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**-**
CO5	**1**	**2**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**2**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

FD24201 – BIOCHEMISTRY AND NUTRITION								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
II	3	0	0	45	3	40	60	100

Course Objective

- To recall the importance and application of bio molecules.
- To examine the classification and properties fats.
- To learn metabolism of carbohydrate and lipid
- To learn structural functions and properties of proteins and nucleic acids.
- To impart classification and nomenclature of enzymes.

UNIT I – CARBOHYDRATES	**9**

Sources, Classification, function, structure and properties of mono (glucose, Fructose, galactose), di (Sucrose, Maltose, Lactose), oligo (Raffinose) & polysaccharides (Starch & Cellulose). Sugar - properties – sugar Hygroscopicity and solubility, optical rotation, mutarotation, Application of sugar in food industries; sensory properties-sweetness index, Dextrose Equivalent, Degree of polymerisation; Sugar alcohols – Natural and Artificial Sweetener.	
UNIT II - LIPIDS Classification & nomenclature of lipids- Types of fatty acids –physical and chemical properties of lipids: specific properties - crystal formation, polymorphism, plasticity, isomerization, hydrolytic rancidity and oxidative rancidity. Shortening power of fats, tenderization, emulsification, frying - smoke point, auto-oxidation, inter-esterification and polymerization. Biological role of lipids.	**9**
UNIT III - METABOLISM OF CARBOHYDRATE AND LIPID Metabolic pathways - Types and chemical reactions Glycolysis: Anaerobic path way of glucose metabolism, energy balance sheet and regulation – citric acid cycle: aerobic pathway of glucose metabolism – modification of citric acid cycle, lipid metabolism: fatty acid metabolism, Beta oxidation of saturated and unsaturated fatty acids, energetics of beta oxidation – bio synthesis of lipid and cholesterol.	**9**
UNIT IV - PROTEINS AND NUCLEIC ACIDS Structure and classification of amino acids – proteins :primary structure, Secondary structure, Tertiary structure and quaternary structure – central dogma, aggregated proteins, structural importance and function, denaturation and renaturation – Nucleic acids: structure of nucleic acids, structure of DNA, Types of RNA and their structures and its importance.	**9**
UNIT V - ENZYMES Introduction, function, classification and nomenclature of enzymes – mechanism of enzyme action - michaelis- menten hypothesis; active site – enzyme models –enzyme activity and modifiers – enzyme inhibititon, factors affecting enzyme activity – application of enzymes in food industries, immobilization methods.	**9**
Total Hours	**45**

Textbook(s)

1	David L. Nelson and Michael M. Cox. Lehninger Principles of Biochemistry, 6th Ed. Macmillan Learning, NY, USA, 2012.
2	"Murray, Robert K.., Harper Illustrated Biochemistry, 27th Edition. McGraw-Hill, 2006.

Reference(s)

1	Donald Voet and Judith G. Voet." Biochemisry", 4th Ed. John Wiley and Sons, Inc., NY, USA, 2011
2	H.D.Belitz, W. Grosch, P. Schieberle, "Food Chemistry",Springer,2009.
3	Satyanarayanan. U, "Biochemistry" Books and Allied (P) Ltd., 2005.
4	Rastogi S.C., "Biochemistry", 3rd Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.

On the successful completion of the course, students will be able to

Course Outcome		Level
CO1	Understand types and importance of carbohydrates.	K1
CO2	Categorize the structure, composition and properties of fats.	K2
CO3	Illustrate the metabolism of carbohydrate and lipid.	K1
CO4	Know the structural functions and properties of proteins and nucleic acid.	K2
CO5	Describe the nature, function, classification and nomenclature of enzymes.	K1

Mapping with Program Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	2	1	3	2	-	-	-	-	-	-	1	2	1
CO2	3	3	2	1	3	2	-	-	-	-	-	-	1	2	1
CO3	3	3	2	1	3	2	-	-	-	-	-	-	1	2	1
CO4	3	2	1	2	2	2	-	-	-	-	-	-	1	2	1
CO5	3	2	2	1	3	2	-	-	-	-	-	-	1	2	1
3 – Strong, 2 – Medium, 1 – Low															

TA24002 – TAMILS AND TECHNOLOGY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
II	1	0	0	15	1	40	60	100

Course Objective

- Explore the historical development of technology in the Tamil region.
- Examine how traditional Tamil practices and knowledge systems have influenced technological advancements
- Promote inclusivity and diversity in the technology sector, encouraging the participation of Tamils in various technological fields.
- Provide a global perspective on Tamil contributions to technology and the role of Tamils in the global technology landscape.
- Explore the role of the Tamil language in technology, including the development of software, language processing, and digital content in Tamil.

UNIT I - WEAVING AND CERAMIC TECHNOLOGY Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries	**3**

(BRW) – Graffiti on Potteries.	
UNIT II - 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)- ThirumalaiNayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.	**3**
UNIT III - 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 Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.	**3**
UNIT IV - AGRICULTURE AND IRRIGATION TECHNOLOGY Dam, Tank, ponds, Sluice, Significance of KumizhiThoompu of 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.	**3**
UNIT V - 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.	**3**
Total Hours	**15**

Textbook(s)	
1	Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (inprint).
2	Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
Reference(s)	
1	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.)
2	Keeladi - 'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
3	Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
4	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

On the successful completion of the course, students will be able to

Course Outcome		Level
CO1	Understand the extensive literature of Tamil and its classical nature.	K1
CO2	Understand the heritage of sculpture, painting and musical instruments of ancient people.	K2
CO3	Review on folk and martial arts of Tamil people.	K2
CO4	Realization of Thinai concepts, trade and victory of chozha dynasty.	K2
CO5	Understand the contribution of Tamils in Indian freedom struggle, self-esteem movement and siddha medicine.	K2

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO5	2	-	-	-	-	-	-	-	-	-	-	1	-	-	-
3 – Strong, 2 – Medium, 1 – Low															

TA24002 – தமிழரும் தொழில்நுட்பமும்							
Semester	Hours/Week			Total Hours	Credit	Maximum Marks	
	L	T	P		C	CIAT	ESE	Total
II	1	0	0	15	1	40	60	100

Course Objective

- தமிழ் பிராந்தியத்தில் தொழில்நுட்பத்தின் வரலாற்று வளர்ச்சியை ஆராய்ச்சி செய்யுங்கள்.
- பாரம்பரிய தமிழ் நடைமுறைகளும் அறிவு அமைப்புகளும் தொழில்நுட்ப முன்னேற்றங்களை எவ்வாறு பாதித்துள்ளன என்பதை ஆராயுங்கள்
- பல்வேறு தொழில்நுட்பத் துறைகளில் தமிழர்களின் பங்கேற்பை ஊக்குவித்தல், தொழில்நுட்பத் துறையில் உள்ளடக்கம் மற்றும் பன்முகத்தன்மையை ஊக்குவித்தல்.
- தொழில்நுட்பத்திற்கான தமிழ் பங்களிப்புகள் மற்றும் உலகளாவிய தொழில்நுட்ப நிலப்பரப்பில் தமிழர்களின் பங்கு பற்றிய உலகளாவிய கண்ணோட்டத்தை வழங்கவும்.

• மென்பொருளின் வளர்ச்சி, மொழி செயலாக்கம், தமிழில் டிஜிட்டல் உள்ளடக்கம் உள்ளிட்ட தொழில்நுட்பத்தில் தமிழ் மொழியின் பங்கை ஆராயுங்கள்.	
அலகு I - நெசவு மற்றும் பானைத் தொழில்நுட்பம்: சங்க காலத்தில் நெசவுத் தொழில் பானைத் தொழில்நுட்பம் கருப்பு சிவப்பு பாண்டங்கள் - பாண்டங்களில் கீறல் குறியீடுகள்.	**3**
அலகு II - வடிவமைப்பு மற்றும் சுட்டிடத் 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.	**3**
அலகு III - 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.	**3**
அலகு IV - 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 - அறிவுசார சமூகம்.	**3**
அலகு V - 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.	**3**
Total Hours	**15**

Textbook(s)	
1	தமிழக வரலாறு - மக்களும் பண்பாடும் - கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2	கணினித் தமிழ் - முனைவர் இல சுந்தரம். (விகடன் பிரசுரம்).
Reference(s)	
1	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.
2	Studies in the History of India with special reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
3	Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

On the successful completion of the course, students will be able to

Course Outcome		Level
CO1	தமிழின் விரிவான இலக்கியங்களையும் அதன் செம்மொழித் தன்மையையும் புரிந்து கொள்ளுங்கள்.	K1
CO2	பழங்கால மக்களின் சிற்ப ஓவியம் மற்றும் இசைக்கருவிகளின் பாரம்பரியத்தைப் புரிந்து கொள்ளுங்கள்	K2
CO3	தமிழ் மக்களின் நாட்டுப்புற மற்றும் தற்காப்பு கலைகள் பற்றிய ஆய்வு.	K2
CO4	திணை கருத்துக்கள், வர்த்தகம் மற்றும் சோழ வம்சத்தின் வெற்றி.	K2
CO5	இந்திய சுதந்திரப் போராட்டத்திலும், சுயமரியாதை இயக்கத்திலும், சித்த மருத்துவத்திலும் தமிழர்களின் பங்களிப்பைப் புரிந்து கொள்ளுங்கள்	K2

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-
CO2	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-
CO3	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-
CO4	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-
CO5	**2**	-	-	-	-	-	-	-	-	-	-	**1**	-	-	-
3 – Strong, 2 – Medium, 1 – Low															

MN24002 – ENVIRONMENTAL SCIENCE AND SUSTAINABILITY							
Semester	Hours/Week			Total Hours	Credit	Maximum Marks	
	L	T	P		C	CIAT	ESE	Total
II	3	0	0	30	0	100	0	100

Course Objective

- To introduce the basic concepts of environment, ecosystems and biodiversity and emphasizeon the biodiversity of India and its conservation.
- To impart knowledge on the causes, effects and control or prevention measures of environmental pollution and natural disasters.
- To facilitate the understanding of global and Indian scenario of renewable and nonrenewable resources, causes of their degradation and measures to preserve them.
- To familiarize the concept of sustainable development goals and appreciate the interdependence of economic and social aspects of sustainability, recognize and analyze climate changes, concept of carbon credit and the challenges of environmental management.
- To inculcate and embrace sustainability practices and develop a broader understanding on green materials, energy cycles and analyze the role of sustainable urbanization.

UNIT I - ENVIRONMENT AND BIODIVERSITY Definition, scope and importance of environment – need for public awareness. Eco-system and Energy flow – ecological succession. Biodiversity - Types of biodiversity: genetic, species and ecosystem biodiversity – Values of biodiversity, India as a megadive/rsity nation – hot-spots of biodiversity – Threats to biodiversity - habitat loss, poaching of wildlife, man-	**6**

wildlife conflicts – Endangered and Endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation.	
UNIT II - ENVIRONMENTAL POLLUTION Causes, Effects and Preventive measures of Air pollution, Water pollution, Soil pollution and Noise pollution. Solid, Hazardous and E-Waste management. Environmental protection, Environmental protection acts.	**6**
UNIT III - RENEWABLE SOURCES OF ENERGY Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.	**6**
UNIT IV - SUSTAINABILITY AND MANAGEMENT Development, GDP, Sustainability - concept, needs and challenges - economic, social and aspects of sustainability - from unsustainability to sustainability - millennium development goals, and protocols - Sustainable Development Goals - targets, indicators and intervention areas Climate change - Global, Regional and Local environmental issues and possible solutions - case studies. Concept of Carbon Credit, Carbon Footprint. Environmental management in industry - A case study.	**6**
UNIT V - SUSTAINABILITY PRACTICES Zero waste and R concept, Circular economy, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy: Non-conventional Sources, Energy Cycles - carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization - Socio-economical and technological change.	**6**
Total Hours	**30**

Textbook(s)	
1	Anubha Kaushik and C. P. Kaushik's "Perspectives in Environmental Studies", 6th Edition,New Age International Publishers, 2018.
2	Benny Joseph, "Environmental Science and Engineering", Tata McGraw Hill, New Delhi, 2016.
Reference(s)	
1	R. K. Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media. 38. Edition, 2010.
2	Cunningham, W.P. Cooper, T.H. Gorhani, "Environmental Encyclopedia", Jaico Publ., House, Mumbai, 2001.
3	Dharmendra S. Sengar, "Environmental law", Prentice hall of India Pvt. Ltd, New Delhi, 2007.
4	Rajagopalan, R, "Environmental Studies - From Crisis to Cure", Oxford University Press, 3rd Edition, 2015.
5	Erach Bharucha "Textbook of Environmental Studies for Undergraduate Courses" Orient Blackswan Pvt. Ltd. 2013.

On the successful completion of the course, students will be able to

	Course Outcome	Level
CO1	To recognize and understand the functions of environment, ecosystems and biodiversity and their conservation.	K1
CO2	To identify the causes, effects of environmental pollution and natural disasters and contributeto the preventive measures in the society.	K1
CO3	To identify and apply the understanding of renewable and non-renewable resources and contribute to the sustainable measures to preserve	K3

	them for future generations.	
CO4	To recognize the different goals of sustainable development and apply them for suitable technological advancement and societal development.	K2
CO5	To demonstrate the knowledge of sustainability practices and identify green materials, energycycles and the role of sustainable urbanization	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**2**	**1**	**-**	**-**	**-**	**2**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO2	**3**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO3	**3**	**-**	**1**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO4	**3**	**2**	**1**	**1**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**
CO5	**3**	**2**	**1**	**-**	**-**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low															

FD24411 - BIOCHEMISTRY AND NUTRITION LABORATORY							
Semester	Hours/Week			Total Hours	Credit	Maximum Marks	
	L	T	P		C	CIAT	ESE	Total
II	0	0	4	60	2	60	40	100

Course Objective

- To understand basic measurement in food biochemistry.
- To explain basic chemical analysis.
- To understand basic chemistry involved in food testing.
- To use knowledge in anthropometry.
- To connect the different clinical requirements.

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.
Total Hours	**60**

Reference(s)

1	R.C. Gupta and S. Bhargavan. "Practical Biochemistry", CBS Publishers, 1992.
2	David T. Phummer. "Introduction to Practical Biochemistry", II Edition, Tata McGraw-Hill, 1988.
3	Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.

On the successful completion of the course, students will be able to

Course Outcome		Level
CO1	Explain basic measurement in food processing.	K1
CO2	Understand the basic chemical analysis.	K1
CO3	Apply the learnt basic chemistry involved in food testing.	K3
CO4	Use the nutritional anthropometry.	K2
CO5	Connect the clinical status of the individuals.	K1

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	2	-	-	-	-	3	2	3
CO2	2	2	2	2	2	2	1	1	-	-	-	-	3	2	2
CO3	1	1	1	1	1	1	-	-	-	-	-	-	1	1	1
CO4	1	1	1	1	1	1	-	-	-	-	-	-	1	1	1
CO5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

3 – Strong, 2 – Medium, 1 – Low

CS24002 – PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
II	0	0	4	60	2	60	40	100

Course Objectives

- To understand the problem solving approaches.
- To learn the basic programming constructs in Python.
- To practice various computing strategies for Python-based solutions to real world problems.
- To use Python data structures - lists, tuples, dictionaries.
- To do input/output with files in Python.

LIST OF EXPERIMENTS:	
1. Write a program for checking the given number is even or odd. .	
2. Write a program for displaying reversal of a number.	
3. Write a program for finding biggest number among 3 numbers.	
4. Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.	
5. Implement python script to check the given year is leap year or not. .	
6. Implement Python Script to generate first N natural numbers.	
7. Implement Python Script to check given number is palindrome or not.	
8. Implement Python script to print factorial of a number.	
9. Implement Python Script to print sum of N natural numbers.	
10. Implement Python Script to check given number is Armstrong or not.	
11. Implement Python Script to generate prime numbers series up to n	
12. Finding the minimum and maximum elements in the lists	
13. Define a function max_of_three() that takes three numbers as arguments and returns the largest of them.	
14. Implement a python script for factorial of number by using recursion	
15. Implement a python script to check the element is in the list or not by using Linear search & Binary search	
16. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).	
17. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)	
18. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)	
Total Hours	**60**

Reference(s)

1	Paul Deitel, Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2	John V Guttag, “Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, 3rd Edition, MIT Press, 2021.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Develop algorithmic solutions to simple computational problems.	K2
CO2	Develop and execute simple Python programs.	K2
CO3	Write simple Python programs using conditionals and loops for solving problems.	K3
CO4	Decompose a Python program into functions.	K3
CO5	Represent compound data using Python lists, tuples, dictionaries etc.	K3

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	-	-	-	-	-	2	2	3	3	-
CO2	3	3	3	3	2	-	-	-	-	-	2	2	3	-	-
CO3	3	3	3	3	2	-	-	-	-	-	2	-	3	-	-
CO4	2	2	-	2	2	-	-	-	-	-	1	-	3	-	-
CO5	1	2	-	-	1	-	-	-	-	-	1	-	2	-	-

3 – Strong, 2 – Medium, 1 – Low

MA24306 – FOURIER AND LAPLACE TRANSFORM

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	3	1	0	60	4	40	60	100

Course Objectives

- Explain the linear differential equations using Laplace transform.
- Understand Fourier series analysis to various engineering applic c ations beyond its traditional role in solving boundary value problems.
- Analyze with Fourier Transform techniques used in wide variety of situations.
- Solve the standard techniques in complex variable theory, with particular emphasis on analytic functions and their mapping properties.
- Develop skills in complex integration and contour integration techniques, particularly their applications in evaluating real integrals.

UNIT I – LAPLACE TRANSFORM Laplace transform-Sufficient conditions for existence-Transform of elementary functions-Basic Properties-Transform of derivatives and integral functions-Derivatives and integrals of transforms-Transforms of unit step function and impulse functions-Transform of periodic	**12**

functions. Inverse Laplace Transform-Statement of convolution theorem-Initial and final value theorems-Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.	
UNIT II – FOURIER SERIES Periodic functions-Dirichlet's Conditions-General Fourier Series-Odd and even functions-Half range sine series-Half range cosine series- Complex form of Fourier series-Parseval's Identity-Harmonic analysis.	**12**
UNIT III – FOURIER TRANSFORMS Statement of Fourier integral theorem-Fourier transform pair- Fourier sine and cosine transforms-Properties-Transforms of simple functions-Convolution theorem-Parseval's Identity.	**12**
UNIT IV - COMPLEX DIFFERENTIATION Analytic functions-Cauchy's Riemann Equations and other properties- Harmonic functions-Construction of analytic function by Milne's-Thomson method – Conformal mapping – Mapping by functions $w=c+z$, az, $1/z$, z^2 – Bilinear transformation.	**12**
UNIT V - COMPLEX INTEGRATION Cauchy's Integral theorem and Integral Formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).	**12**
Total Hours	**60**

Textbook(s)	
1	Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2	Grewal.B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2018.
3	Bali N.P and Manish Goyal, "A text book of Engineering Mathematics". Eighth Edition,Laxmi Publications Pvt Ltd., 2011.
Reference(s)	
1	Veerarajan. T., "Transforms and Partial Differential Equations", Second reprint, Tata Mc Graw Hill Education Pvt.Ltd., New Delhi,2012.
2	Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd), New Delhi, 7th Edition, 2009.
3	Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 5th Edition, 2016.
4	Datta. K.B., "Mathematical Methods of Science and Engineering,' Cengage Learning India Pvt Ltd, Delhi,2013.
5	Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, New Delhi, 2016.

6	Srimantha Pal and Bhunia. S.C, "Engineering Mathematics" Oxford University Press, 2015.

On the successful completion of the course, students will be able to

Course Outcomes		Level
CO1	Explain Laplace transform and Inverse transform techniques in solving differential equations.	K1
CO2	Understand the use of periodic signals and Fourier series in the analysis of electrical circuits and systems.	K1
CO3	Apply Fourier transform techniques as a tool for solving integral equations.	K3
CO4	Solve techniques of complex variable theory, especially analytic functions and their mapping properties, to solve relevant mathematical problems.	K3
CO5	Develop the principles of complex and contour integration techniques and their relevance to evaluating real integrals.	K4

Mapping with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**
CO2	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**
CO3	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**
CO4	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**	**-**

FD24301 – INTRODUCTION TO IoT IN FOOD PROCESSING								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Explain the concepts of the Internet of Things (IoT) and how it is applied in food processing.
- Interpret the types of sensors, actuators, and data communication technologies used in IoT-enabled food systems.
- Evaluate the integration of IoT systems in monitoring and controlling food production, storage, and distribution processes.
- Develop practical skills in IoT-based solutions for improving food quality, safety, and efficiency.
- Implement the industrial applications of IoT in food processing.

UNIT I - INTRODUCTION TO IoT & FUNDAMENTALS OF FOOD PROCESSING Overview of IoT: Definition, components, and applications - IoT in the context of food processing: Introduction to smart food systems - Communication protocols: Bluetooth, Zigbee, Wi-Fi, and LoRa - IoT architecture and layers - Data collection, transmission, and	**9**

analysis in food processing - Food processing operations overview (e.g., cooking, packaging, refrigeration, storage).	
UNIT II - IoT SENSORS & ACTUATORS IN FOOD PROCESSING Sensors used in IoT: Types (temperature, humidity, pH, gas, optical, etc.) - Actuators and their role in automation of food processes - Wireless sensor networks (WSN) in food applications - Smart sensors for real-time monitoring of food quality and safety - Case studies of IoT sensor applications in food production (e.g., real-time temperature monitoring in cold chains).	**9**
UNIT III - IoT-ENABLED MONITORING SYSTEMS IN FOOD PROCESSING Monitoring food production processes with IoT: Quality control, process optimization - IoT in cold chain monitoring: Temperature and humidity control - IoT applications for food safety: Monitoring contamination, HACCP compliance - Smart packaging: RFID and IoT for inventory management and traceability - Cloud-based solutions for food data management: Data storage, analytics, and visualization.	**9**
UNIT IV - IoT IN FOOD SUPPLY CHAIN MANAGEMENT Real-time tracking and monitoring of food products in the supply chain - IoT applications for logistics, transportation, and delivery of food products - Smart farming and IoT in agriculture: Sensors for crop health, soil quality, and climate monitoring - Blockchain and IoT for traceability and transparency in food supply chains - Challenges in implementing IoT in food supply chains.	**9**
UNIT V - IOT-BASED DATA ANALYTICS AND AI APPLICATIONS IN FOOD PROCESSING Introduction to Data Analytics for IoT in Food Processing: The role of data analytics in IoT systems: From raw data to actionable insights - Techniques for processing and analyzing large volumes of IoT data - Tools for data visualization: Dashboards, real-time analytics, and predictive maintenance - Optimizing food manufacturing processes through AI-driven insights - AI applications for quality control - Intelligent food processing systems - Data privacy and security concerns in IoT-enabled food systems - Ethical use of AI in food processing: Bias, transparency, and accountability - Overcoming scalability and integration challenges in AI/IoT deployments.	**9**
Total Hours	**45**

Textbook(s)

1.	Liu, Y., & Zhang, J. (2019). Internet of Things in Food Processing and Food Safety. CRC Press.
2.	Bandyopadhyay, S., & Sen, J. (2019). IoT and Cloud Computing for Food and Beverage Industries. Springer.

Reference(s)

1.	He, H. (2020). IoT for Smart and Connected Cities. Wiley-IEEE Press.
2.	Min, H. (2016). Smart Logistics: Technology and Applications. CRC Press.
3.	Lee, C., & Chen, L. (2020). Emerging Technologies in Food Processing. Wiley-Blackwell.
4.	Zhang, J., & Wang, C. (2020). Sensors and Actuators in Food Processing Applications: A Guide to Internet of Things. Elsevier.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Summarize the core principles of the Internet of Things (IoT) and its relevance to the food industry.	K2
CO2	Identify the types of sensors, actuators, and communication protocols used in IoT systems for food monitoring and control.	K3
CO3	Analyze and design IoT-based systems for real-time monitoring of food quality and safety.	K4
CO4	Develop IoT solutions for optimizing food supply chain management and improving traceability in food processing.	K3
CO5	Evaluate the integration of IoT technologies in food safety and regulatory compliance.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	3	2	2	-	-	-	2	2	2	2
CO2	3	2	1	-	3	2	2	-	-	-	2	2	2	2
CO3	3	3	2	1	3	2	2	-	-	-	2	2	2	2
CO4	3	2	1	-	3	2	2	-	-	-	2	2	2	2
CO5	3	3	2	1	3	2	2	-	-	-	2	2	2	2
3 – Strong, 2 – Medium, 1 – Low														

FD24302 – COMPUTATIONAL FLUID MECHANICS IN FOOD PROCESSES								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	3	0	0	60	3	40	60	100

Course Objective

The goal of this course is for students to,

- Explain the basic mechanics of fluids through a thorough understanding of the properties of the fluids, behaviour of fluids in different medians.
- Interpret the fundamental principles and governing equations of Computational Fluid Dynamics (CFD) relevant to food processes.
- Design and simulate fluid flow and heat/mass transfer in food systems using computational tools.
- Apply CFD for analyzing processes such as mixing, drying, refrigeration, pasteurization, and aerodynamics in food engineering.
- Develop skills in mesh generation, boundary condition setup, and numerical solution of

governing equations.	
UNIT I - BASICS OF FLUID MECHANICS Properties of fluids - Basic equation and essential of fluid statics - Pressure measuring devices - Basic equations in integral form - Basic 68 laws for a system and continuity equations - Types of fluid flow- Fluid pressure and measurement - simple, differential and micro manometers - Mechanical gages – calibration - Pressure diagram - Total pressure on curved surface - Archimedes principles - flow measurements & open channel flow - Dimensional analysis & pumps	**12**
UNIT II - INTRODUCTION TO CFD & GOVERNING EQUATIONS Introduction to CFD and its role in food processing. - Fundamental conservation laws: Mass, momentum, and energy conservation. - Classification of PDEs: Elliptic, parabolic, and hyperbolic equations. - Physical meaning and derivation of Navier-Stokes equations - Assumptions for simplification in food-related processes - Overview of numerical methods: Finite difference, finite volume, and finite element methods.	**12**
UNIT III - DISCRETIZATION TECHNIQUES AND SOLUTION STRATEGIES Finite Difference Method (FDM): Forward, backward, central schemes - Finite Volume Method (FVM): Control volume approach, flux evaluation - Grid and mesh generation: Structured vs. unstructured meshes, quality criteria - Time discretization: Explicit vs. implicit methods - Stability analysis: Courant number, CFL condition - Convergence and residual monitoring.	**12**
UNIT IV - BOUNDARY CONDITIONS & TURBULENCE MODELING Common boundary conditions in food processing: no-slip, symmetry, inlet, outlet - Initial conditions and transient flow setup - Introduction to turbulence and relevance in food systems - Turbulence models: k-ε, k-ω, LES, DNS (basic overview) - Validation and verification of CFD models.	**12**
UNIT V - CFD APPLICATIONS IN FOOD PROCESSING CFD in mixing and agitation of food pastes and liquids - Heat transfer applications: pasteurization, blanching, drying - CFD for cold chain modeling: Refrigeration, freezing, and thawing - Airflow and moisture transport in drying chambers - Simulation of food extrusion and spray drying - CFD case studies using software like ANSYS Fluent/OpenFOAM.	**12**
Total Hours	**60**

Textbook(s)

1.	Sharma, A. (2021). *Introduction to computational fluid dynamics: development, application and analysis*. Springer Nature.
2.	Tu, J., Yeoh, G. H., Liu, C., & Tao, Y. (2023). *Computational fluid dynamics: a practical approach*. Elsevier.
3.	Anderson, D., Tannehill, J. C., Pletcher, R. H., Munipalli, R., & Shankar, V. (2020). *Computational fluid mechanics and heat transfer*. CRC press.

Reference(s)

1.	Lauga, E. (2020). *The fluid dynamics of cell motility* (Vol. 62). Cambridge University Press.
2.	Gerhart, A. L., Hochstein, J. I., & Gerhart, P. M. (2020). *Munson, Young and Okiishi's fundamentals of fluid mechanics*. John Wiley & Sons.
3.	Elger, D. F., LeBret, B. A., Crowe, C. T., & Roberson, J. A. (2020). *Engineering fluid mechanics*.

	John Wiley & Sons.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Illustrate the basic mechanics of fluids in different medians.	K2
CO2	Infer the fundamental principles of computational fluid mechanics and heat transfer in food processing systems.	K2
CO3	Evaluate the discretization techniques and numerical methods used in Computational Fluid Dynamics (CFD).	K5
CO4	Develop and simulate various fluid flow regimes, including laminar and turbulent flows in food processing environments.	K6
CO5	Apply CFD techniques to simulate and optimize food processing operations, such as mixing, heat transfer, and drying.	K4

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	1	2	-	-	-	2	2	2	2
CO2	2	1	-	-	1	1	2	-	-	-	2	2	2	2
CO3	3	3	3	2	1	1	2	-	-	-	2	2	2	2
CO4	3	3	3	3	1	1	2	-	-	-	2	2	2	2
CO5	3	3	2	1	1	1	2	-	-	-	2	2	2	2
3 – Strong, 2 – Medium, 1 – Low														

FD24303 – FOOD PROCESS CALCULATIONS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Define the basic units in food processing.
- Interpret the basic humidity calculations of food materials.
- Assess material balance for process operations with respect to mass transfer in food processing.
- Evaluate energy balance calculations based on energy transfer between food molecules.
- Infer enthalpy - based calculations in drying process.

UNIT I – UNITS AND DIMENSIONS Fundamental and Derived Units: Understanding SI units and their applications in food engineering - Dimensional Analysis: Techniques for checking the consistency of equations - Conversions: Methods for converting units and equations - Ideal and Real Gas Laws: Applications of gas laws in food processing - Gas Constant Calculations: Determining the gas constant for different gases - Mixtures and Solutions: Compositions and calculations involving mixtures and solutions.	**9**
UNIT II – HUMIDITY CALCULATIONS Humidity Concepts: Absolute, relative, and molal humidity - Dew Point: Determining the temperature at which air becomes saturated - Psychrometric Chart: Using the chart for various calculations - Applications: Role of humidity in condensation, drying, and food preservation.	**9**
UNIT III - STOICHIOMETRY AND MATERIAL BALANCE Stoichiometric Principles: Understanding mole concepts, mole fraction, and compositions of mixtures - Material Balance: Application of material balance to unit operations like distillation, evaporation, crystallization, drying, extraction, and leaching - Bypass, Recycle, and Purge: Handling complex systems in food processing.	**9**
UNIT IV - ENERGY BALANCE Heat Capacity: Determining heat capacity of solids, liquids, gases, and solutions - Sensible and Latent Heat: Calculations involving heat changes without and with phase changes - Enthalpy: Evaluation of enthalpy changes in various processes - Energy Balance: Application of energy balance in systems without chemical reactions.	**9**
UNIT V – ENTHALPY Heat of Reaction: Standard heat of reaction, heats of formation, combustion, solution, and mixing - Effect of Pressure and Temperature: Influence on heat of reaction - Energy Balance: Application in systems without chemical reactions - Psychrometric Chart: Use of the chart in energy balance calculations.	**9**
Total Hours	**45**

Textbook(s)	
1.	Gavhane K.A., "Introduction to Process Calculations",First Edition, NiraliPrakashan Publications, 2016.
2.	Rao, D. G. (2023). *Fundamentals of food engineering*. PHI Learning Pvt. Ltd..
Reference(s)	
1.	Fellows, P. J. (2022). *Food processing technology: principles and practice*. Woodhead publishing.
2.	Tucker, G., & Featherstone, S. (2021). *Essentials of thermal processing*. John Wiley & Sons.
3.	Rahman, M. S. (Ed.). (2020). *Handbook of food preservation*. CRC press.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Apply unit conversion and dimensional analysis to food process engineering problems.	K3
CO2	Analyze humidity and psychrometric conditions for food preservation and drying operations.	K4
CO3	Formulate stoichiometric calculations and material balances for various food processes.	K6
CO4	Interpret the law of thermodynamics to perform energy balances in food operations.	K5
CO5	Assess enthalpy changes and integrate energy and mass balances in practical food systems.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	1	2	2	-	-	-	2	2	2	2
CO2	3	3	2	1	1	2	2	-	-	-	2	2	2	2
CO3	3	3	3	3	1	2	2	-	-	-	2	2	2	2
CO4	3	3	2	1	1	2	2	-	-	-	2	2	2	2
CO5	3	3	2	1	1	2	2	-	-	-	2	2	2	2
3 – Strong, 2 – Medium, 1 – Low														

FD24304 – FOOD MICROBIOLOGY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Describe the basic concepts and factors affecting the growth of microorganisms.
- Define the preservation of foods using temperature as a parameter.
- Analyze the role of drying, additives and radiation in the food preservation.
- Identify the microorganisms associated with the food fermentation processes.
- Explain about the food borne illness and sanitation in food industries.

UNIT I – FOOD AND MICROORGANISMS General concepts about molds, bacteria and yeasts. Factors affecting growth of microorganisms – pH, water activity, oxidation – reduction potential, nutrient content, inhibitory substances and biological structure – combined effects of factors affecting growth. Genetically modified crops and its health effects.	**9**
UNIT II – CONTROL OF MICROBES IN FOODS	**9**

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.	
UNIT III - FOOD FERMENTATION 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.	**9**
UNIT IV - FOOD BORNE ILLNESS Food borne infections and food poisoning, microbial toxins, Gram Negative and Gram-positive food borne pathogens; toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.	**9**
UNIT V – 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 food borne pathogens; Applications of immunological, techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, Cl. Botulimum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.	**9**
Total Hours	**45**

Textbook(s)	
1.	Adams, M. R., McClure, P. J., & Moss, M. O. (2024). *Food microbiology*. Royal society of chemistry.
2.	Doyle, M. P., Diez-Gonzalez, F., & Hill, C. (Eds.). (2020). *Food microbiology: fundamentals and frontiers*. John Wiley & Sons.
3.	Matthews, K. R., Kniel, K. E., & Critzer, F. J. (2025). *Food microbiology: an introduction*. John Wiley & Sons.
Reference(s)	
1.	Green, L. H., & Goldman, E. (Eds.). (2021). *Practical handbook of microbiology*. CRC press.
2.	Parija, S. C. (2023). *Textbook of microbiology and immunology* (Vol. 1579). Berlin, Heidelberg, Germany: Springer.
3.	Dubey, R. C., & Maheshwari, D. K. (2023). *A textbook of microbiology*. S. Chand Publishing.

On the successful completion of the course, students will be able to,

Course Outcome		**Level**
CO1	Classify the microorganism and identify the microorganism associated with foods.	K2
CO2	Apply the preservation methods to control the spoilage and assess the	K3

	microbial growth in foods.	
CO3	Analyze the importance of microorganism in food fermentation and fermented products.	K4
CO4	Assess the cause for food borne illness and control the quality control for safety of foods.	K5
CO5	Evaluate the microorganism responsible for spoilage of foods and its assessments.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	-	-	-	2	2	2	2
CO2	3	2	1	-	1	2	2	-	-	-	2	2	2	2
CO3	3	3	2	1	1	2	2	-	-	-	2	2	2	2
CO4	3	3	3	2	1	2	2	-	-	-	2	2	2	2
CO5	3	3	3	2	1	2	2	-	-	-	2	2	2	2
3 – Strong, 2 – Medium, 1 – Low														

FD24321 – FOOD CHEMISTRY								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
III	2	0	4	90	4	40	60	100

Course Objective

The goal of this course is for students to,

- Describe the molecular structure, properties, and functional roles of food macronutrients.
- Analyze the impact of processing, storage, and environmental conditions on the stability and reactivity of food components.
- Infer the role of enzymes, vitamins, minerals, and water in maintaining nutritional quality and food safety.
- Assess the natural pigments, flavors, and phytochemicals, along with their functions in food systems and health.
- Apply chemical principles to innovate and improve food products with enhanced nutritional, sensory, and functional properties.

UNIT I – CARBOHYDRATES IN FOODS Classification and chemical structure - Functional properties: gelatinization, retrogradation, Maillard reaction - Dietary fibers and prebiotics - Resistant starch and metabolic benefits - Modified starches and sugar substitutes - Sugar alcohols and high-intensity sweeteners.	**9**
UNIT II – PROTEINS AND ENZYMES Protein structure and classification - Functional properties in food systems - Enzymes in food processing and spoilage - Plant-based proteins and meat analogs - Textured vegetable proteins - Bioactive peptides and allergenicity.	**9**

UNIT III - LIPIDS IN FOOD SYSTEMS Structure and classification of lipids - Functional roles: emulsification, plasticity, shortening - Lipid oxidation and rancidity - Omega-3, omega-6, and trans fats - Fat modification: hydrogenation, interesterification - Fat replacers and lipid-based functional foods.	**9**
UNIT IV - WATER, VITAMINS, AND MINERALS Water activity and food stability - Classification and stability of vitamins - Mineral composition and bioavailability - Effects of processing on micronutrients - Fortification and encapsulation techniques - Controlled-release nutrient delivery.	**9**
UNIT V – AROMA, PIGMENTS, AND PHYTOCHEMICALS Natural and synthetic flavor compounds - Pigments: carotenoids, anthocyanins, chlorophylls - Functional roles of phytochemicals - Antioxidants and health-promoting compounds - Flavor encapsulation and clean-label trends - Enzymatic and non-enzymatic browning.	**9**
Total Hours	**45**

Textbook(s)

1.	Coultate, T. (2023). *Food: the chemistry of its components*. Royal Society of Chemistry.
2.	Miller, D. D., & Yeung, C. K. (2022). *Food chemistry: A laboratory manual*. John Wiley & Sons.

Reference(s)

1.	Varghese, S. M., Parisi, S., Singla, R. K., & Begum, A. A. (2022). *Trends in food chemistry, nutrition and technology in Indian sub-continent*. Berlin/Heidelberg, Germany: Springer.
2.	Cornell, H., & Hoveling, A. W. (2020). *Wheat: chemistry and utilization*. CRC press.
3.	Damodaran, S., Parkin, K. L., & Fennema, O. R. (2017). Fennema's Food Chemistry. CRC Press.

List of Experiments

1. Estimation of Reducing Sugars using DNS Method
2. Observation of Maillard Reaction and Caramelization in Foods
3. Extraction and Gelatinization of Starch from Plant Sources
4. Preparation of Plant-Based Protein Isolate
5. Effect of pH and Heat on Protein Denaturation
6. Determination of Total Fat using Soxhlet Extraction
7. Estimation of Free Fatty Acids and Peroxide Value in Oils
8. Measurement of Water Activity and Moisture Content in Foods
9. Estimation of Vitamin C Content in Fruit Samples
10. Extraction and Analysis of Natural Food Pigments
11. Extraction and Sensory Evaluation of Flavor Compounds

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Summarize the classification, structure, and functional behavior of carbohydrates, including recent developments in dietary fiber, resistant	K2

	starch, and sugar alternatives.	
CO2	Explain the structural and functional properties of proteins and enzymes in food systems and apply this knowledge to understand texturization and protein-based innovations in food.	K2
CO3	Analyze the chemistry of fats and oils, including processing techniques, lipid oxidation, and the nutritional impact of different fatty acids.	K4
CO4	Assess the role of water activity and the stability of vitamins and minerals in processed foods, and understand fortification and delivery systems.	K5
CO5	Evaluate the role of aroma compounds, food pigments, and phytochemicals in flavor development, color retention, and health-related food innovations.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	1	2	2	-	-	-	2	2	2	2
CO2	2	1	-	-	1	2	2	-	-	-	2	2	2	2
CO3	3	3	2	1	1	2	2	-	-	-	2	2	2	2
CO4	3	3	3	2	1	2	2	-	-	-	2	2	2	2
CO5	3	3	3	2	1	2	2	-	-	-	2	2	2	2
3 – Strong, 2 – Medium, 1 – Low														

FD24311 – FOOD MICROBIOLOGY LABORATORY							
Hours/Week			Total Hours	Credit	Maximum Marks		
L	T	P		C	CIAT	ESE	Total
0	0	4	30	2	40	60	100

Course Objective

The goal of this course is for students to,

- Define the fundamental microbiological techniques relevant to food analysis.
- Infer the methods to isolate, culture, and identify microorganisms from food samples.
- Apply aseptic techniques and microbial enumeration methods.
- Analyze the effects of environmental conditions on microbial growth.
- Evaluate the microbial quality and safety of food products.

List of Experiments

1. Preparation and Sterilization of Culture Media
2. Aseptic Techniques and Microbial Inoculation Methods
3. Isolation of Microorganisms from Food Samples
4. Enumeration of Total Plate Count (TPC) in Foods
5. Determination of Coliforms by Most Probable Number (MPN) Method
6. Yeast and Mold Count in Food Samples
7. Gram Staining and Microscopic Observation of Bacteria

8. Biochemical Tests for Identification of Bacteria
9. Antimicrobial Activity of Natural Extracts on Foodborne Microbes
10. Effect of Temperature and pH on Microbial Growth
11. Detection of Pathogens in Milk by MBRT (Methylene Blue Reduction Test)

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Experiment with various methods for preparation and sterilization of microbial media and use of aseptic techniques.	K3
CO2	Analyze the isolate and enumerate bacteria, yeasts, and molds in various food samples.	K4
CO3	Identify foodborne microorganisms using staining and biochemical tests.	K3
CO4	Assess the impact of pH, temperature, and natural antimicrobials on microbial growth.	K6
CO5	Evaluate microbial contamination and safety of dairy and processed foods.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	2	2	2	-	-	2	3	3	2
CO2	3	3	2	1	2	2	2	2	-	-	2	3	3	2
CO3	3	2	1	-	2	2	2	2	-	-	2	3	3	2
CO4	3	3	3	3	2	2	2	2	-	-	2	3	3	2
CO5	3	3	3	2	2	2	2	2	-	-	2	3	3	2
3 – Strong, 2 – Medium, 1 – Low														

MA24402 – PROBABILITY AND STATISTICS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
IV	3	1	0	60	4	40	60	100

Course Objective

The goal of this course is for students to,

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I PROBABILITY AND RANDOM VARIABLES Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Exponential and Normal distributions – Functions of a random variable.	**12**
UNIT II TWO- DIMENSIONAL RANDOM VARIABLES Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).	**12**
UNIT III TESTING OF HYPOTHESIS Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t,Chi-squares and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.	**12**
UNIT IV ESTIMATION THEORY Unbiased estimators - Efficiency - Consistency - Sufficiency - Robustness - Method of moments- Method of maximum Likelihood - Interval estimation of Means - Differences between means,variations and ratio of two variances	**12**
UNIT V STATISTICAL QUALITY CONTROL Control charts for measurements ($\bar{X}$ and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.	**12**
Total Hours	**60**

Textbook(s)

1.	Johnson. R.A., Miller. I.R and Freund . J.E, " Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2.	Milton. J. S. and Arnold. J. C., "Introduction to Probability and Statistics", Tata Mc Graw Hill, 4th Edition, 2007.
3.	John E. Freund, "Mathematical Statistics", Prentice Hall, 5th Edition, 1992

Reference(s)

1.	Gupta. S.C and Kapoor. V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12th Edition, 2020.
2.	Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2014.
3.	Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014.
4.	Speigel. M. R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012
5.	Walpole. R.E., Myers. R.H., Myers. S.L and Ye. K., "Probability and Statistics for Engineers and

	Scientists", Pearson Education, Asia, 9th Edition, 2010.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.	K1
CO2	Understand the basic concepts of one and two dimensional random variables and apply in engineering applications.	K2
CO3	Apply the concept of testing of hypothesis for small and large samples in real life problems.	K4
CO4	Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.	K4
CO5	Have the notion of sampling distributions and statistical techniques used in engineering and management problems	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**
CO2	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**
CO3	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**
CO4	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**
CO5	**3**	**3**	**1**	**1**	**-**	**-**	**-**	**-**	**2**	**-**	**2**	**3**	**-**	**-**
3 – Strong, 2 – Medium, 1 – Low														

FD24401 – THERMODYNAMICS FOR FOOD TECHNOLOGISTS								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
IV	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Outline the fundamental principles and concepts of thermodynamics relevant to food processes.
- Develop an understanding of energy interactions in food systems using the laws of thermodynamics.
- Analyze the thermodynamic properties of pure substances, steam, and refrigerants used in food processing.
- Apply psychrometric principles to drying, humidification, and air-conditioning in food operations.
- Evaluate energy efficiency and sustainability in various food processing and preservation techniques.

UNIT I - FUNDAMENTALS OF THERMODYNAMICS System, boundary, and surroundings – types of systems (open, closed, isolated) - Thermodynamic properties – intensive, extensive, point and path functions - Concepts of state, equilibrium, process (quasi-static, reversible, irreversible) - Work and heat – definitions, displacement work, sign conventions - Concept of continuum – microscopic vs macroscopic approach - P-V diagrams and energy interactions in processes.	**9**
UNIT II - LAWS OF THERMODYNAMICS Zeroth law and temperature scales – Celsius, Fahrenheit, Kelvin - First Law – energy conservation, internal energy, enthalpy - Control mass and control volume energy balance - Second Law – entropy, irreversibility, Carnot cycle, Clausius inequality - Third Law – entropy at absolute zero - Exergy and energy degradation in food systems.	**9**
UNIT III - PROPERTIES OF PURE SUBSTANCES AND STEAM APPLICATIONS Phase changes and P-V-T behavior of pure substances - Use of property tables: steam tables and Mollier charts - Thermodynamic processes involving steam – isothermal, isobaric, adiabatic - Measurement of dryness fraction - Rankine cycle (ideal and actual) and its improvements - Introduction to refrigerants and cooling cycles.	**9**
UNIT IV - GAS MIXTURES AND PSYCHROMETRY Gas mixtures – Dalton's and Amagat's laws - Psychrometric properties – dry bulb, wet bulb, dew point temperatures - Relative humidity, specific humidity, enthalpy of moist air - Psychrometric chart usage and calculations - Cooling, humidification, dehumidification, adiabatic saturation - Air conditioning systems for food storage and drying.	**9**
UNIT V - THERMODYNAMIC APPLICATIONS IN FOOD PROCESSING Thermodynamics of microbial growth - Thermodynamics of maintenance - Operational stoichiometry at different growth rates - Heat production in microbial cultures - Herbert-Pirt relation for electron donors - Thermodynamics of product formation - Stoichiometry of product and by-product formation - Energy efficiency in microbial processes - Introduction to thermodynamic modeling in process design.	**9**
Total Hours	**45**

Textbook(s)

1.	Turns, S. R., & Pauley, L. L. (2020). *Thermodynamics: concepts and applications*. Cambridge University Press.
2.	Lewis, G. N., & Randall, M. (2020). *Thermodynamics*. Courier Dover Publications.
3.	Borgnakke, C., & Sonntag, R. E. (2020). *Fundamentals of thermodynamics*. John Wiley & Sons.
4.	Gaskell, D. R., & Laughlin, D. E. (2024). *Introduction to the Thermodynamics of Materials*. CRC press.

Reference(s)

1.	Moran M.J., Shapiro H.N., *Fundamentals of Engineering Thermodynamics*, 9th Edition, Wiley, 2018.
2.	Swendsen, R. H. (2020). *An introduction to statistical mechanics and thermodynamics*. Oxford University Press.
3.	Honig, J. M. (2020). *Thermodynamics: principles characterizing physical and chemical processes*. Academic Press.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Apply the first and second laws of thermodynamics to solve energy balance problems in food processes.	K3
CO2	Determine thermodynamic properties using steam tables, diagrams, and psychrometric charts.	K5
CO3	Analyze the performance of heating, cooling, and refrigeration systems used in the food industry.	K4
CO4	Estimate the humidity, enthalpy, and other psychrometric parameters relevant to food drying and storage.	K5
CO5	Evaluate thermodynamic efficiency and suggest energy optimization strategies in food manufacturing.	K5

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	2	2	-	-	-	2	2	2	1
CO2	3	3	3	2	2	2	2	-	-	-	2	2	2	1
CO3	3	3	2	1	2	2	2	-	-	-	2	2	2	1
CO4	3	3	3	2	2	2	2	-	-	-	2	2	2	1
CO5	3	3	3	2	2	2	2	-	-	-	2	2	2	1
3 – Strong, 2 – Medium, 1 – Low														

FD24402 – TRANSPORT PHENOMENA AND UNIT OPERATIONS IN FOOD PROCESSES								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
IV	3	1	0	60	4	40	60	100

Course Objective

The goal of this course is for students to,

- Summarize fundamental knowledge of momentum, heat, and mass transfer in food systems.
- Assess key unit operations involved in food processing and preservation.
- Analyze and model transport phenomena in real-world food processes.
- Interpret the modern equipment and sustainable processing technologies in food industries.
- Develop the ability to integrate digital tools and smart systems for process optimization.

UNIT I - PRINCIPLES OF TRANSPORT PHENOMENA Fundamentals of momentum, heat, and mass transfer - Modes of transport and physical significance - Dimensional analysis, similarity principles - Key dimensionless numbers: Reynolds, Prandtl, Schmidt, Nusselt - Role of nano/micro transport in encapsulation and emulsion stability.	**12**
UNIT II - MOMENTUM TRANSFER IN FOOD SYSTEMS Fluid properties Newtonian and non-Newtonian fluids - Flow through pipes: laminar and turbulent regimes - Advanced flow systems: hygienic design, CIP-friendly layouts - Modelling flow of high-viscosity and particulate-laden food slurries - Smart sensors for flow monitoring	**12**

and control - Energy-efficient mixers and shear-sensitive fluid handling.	
UNIT III - HEAT AND MASS TRANSFER IN FOOD SYSTEMS Fundamentals of Heat Transfer– Thermal properties of food (conductivity, diffusivity) - Heat Transfer Equipment and Applications - Advanced Thermal Processing - Fundamentals of Mass Transfer – Fick's laws – Mass transfer coefficients – Diffusion in different phases - Mass Transfer Operations – Advanced drying - Membrane and Packaging Technologies - Mass transfer in fermentation and bioprocessing	**12**
UNIT IV - FUNDAMENTAL UNIT OPERATIONS IN FOOD PROCESSING Basic principles and classification of unit operations – Evaporation - Filtration – Drying – Mechanical separation – Centrifugation – Energy balances in processing equipment – Impact of unit operations on food quality and safety.	**12**
UNIT V - ADVANCEMENTS IN UNIT OPERATIONS IN FOOD PROCESSING Smart equipment integration - cold plasma, pulsed electric field, high-pressure processing – Energy recovery systems in evaporation and concentration – Advanced drying technologies – High-efficiency filtration and membrane technologies – Automation and control in food processing: predictive maintenance and real-time monitoring	**12**
Total Hours	**60**

Textbook(s)	
1.	Plawsky, J. L. (2020). *Transport phenomena fundamentals*. CRC press.
2.	Fellows, P. J. (2022). *Food processing technology: principles and practice*. Woodhead publishing.
3.	Towler, G., & Sinnott, R. (2021). *Chemical engineering design: principles, practice and economics of plant and process design*. Butterworth-Heinemann.
4.	Chhabra, R. P., & Patel, S. A. (2023). *Bubbles, drops, and particles in non-Newtonian fluids*. CRC press.
Reference(s)	
1.	Fellows, P. J. (2022). *Food processing technology: principles and practice*. Woodhead publishing.
2.	Foo, D. (Ed.). (2022). *Chemical engineering process simulation*. Elsevier.
3.	Dincer, I. (2023). *Heat transfer in food cooling applications*. CRC Press.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Apply the principles of transport phenomena in food engineering contexts.	K3
CO2	Analyze fluid flow, heat transfer, and mass transfer mechanisms in food processes.	K4
CO3	Design and optimize key unit operations such as drying, evaporation, and filtration.	K6
CO4	Evaluate performance and energy efficiency of food processing equipment.	K5
CO5	Apply emerging technologies like CFD, IoT, and AI in modern food manufacturing systems.	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	2	2	-	-	-	2	2	2	1
CO2	3	3	2	1	2	2	2	-	-	-	2	2	2	1
CO3	3	3	3	3	2	2	2	-	-	-	2	2	2	1
CO4	3	3	3	2	2	2	2	-	-	-	2	2	2	1
CO5	3	2	1	-	2	2	2	-	-	-	2	2	2	1
3 – Strong, 2 – Medium, 1 – Low														

FD24403 – INSTRUMENTATION AND PROCESS CONTROL IN FOOD PROCESSING								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
IV	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Compare fundamental concepts of instrumentation and measurement techniques in food processing.
- Develop understanding of process control systems, including PID and advanced control strategies.
- Elaborate the use of smart sensors, automation, and IoT in monitoring and controlling food processes.
- Apply process control methods for quality assurance and operational efficiency in food manufacturing.
- Appraise hands-on experience with control systems, simulation tools, and instrumentation setups.

UNIT I - FUNDAMENTALS OF MEASUREMENT AND INSTRUMENTATION Introduction to measurement systems: static & dynamic characteristics - Classification and selection of instruments - Modern sensor technologies: Smart sensors, Wireless sensors, IoT-enabled monitoring - Measurement techniques for key variables: Temperature, Pressure, Flow, Level, pH, Viscosity, Conductivity, Humidity, Color - Signal conditioning and digitization: ADC, filtering, amplifiers - Emphasis on smart sensor integration, real-time data acquisition.	**9**
UNIT II - BASICS OF PROCESS CONTROL SYSTEMS Overview of process control loop components: transmitter, controller, actuator, final control element - Block diagram representation and transfer functions - First- and second-order system dynamics - Controller types: ON-OFF, PID (Proportional–Integral–Derivative) - Introduction to controller tuning (Ziegler-Nichols, software-assisted tuning) - Use of cloud-based tuning and self-adaptive controllers in modern systems.	**9**
UNIT III - ADVANCED CONTROL TECHNIQUES IN FOOD PROCESSING Cascade, Feedforward, Ratio control, Split range control - Multivariable and decoupled control systems - Fuzzy logic and Neural network-based control strategies - Model Predictive	**9**

Control (MPC) in batch and continuous systems - Real-time control with AI/ML tools - AI-enabled decision-making and predictive analytics in control systems.	
UNIT IV - INSTRUMENTATION IN SPECIFIC FOOD PROCESSING OPERATIONS Process control in: Thermal processing (pasteurizers, sterilizers), Drying (spray, freeze, tray), Fermentation systems, Freezing and refrigeration - Measurement tools for food quality and safety: Biosensors, IR spectroscopy, NIR, electronic nose/tongue - Process Analytical Technology (PAT) in food industry - Emphasis on non-destructive and real-time quality assessment tools.	**9**
UNIT V - AUTOMATION, IOT & DATA INTEGRATION IN FOOD PROCESSING PLC, SCADA, and DCS systems overview - Role of Industrial Internet of Things (IIoT) in smart manufacturing - Data integration using OPC-UA, MQTT, and cloud platforms - Cyber-physical systems & cybersecurity in food process automation - Use of Digital Twins and simulation tools in control system design - Complete digitization of process control – from field sensors to cloud analytics.	**9**
Total Hours	**45**

Textbook(s)

1.	Subramanian, G. (Ed.). (2021). *Process control, intensification, and digitalisation in continuous biomanufacturing*. John Wiley & Sons.
2.	Towler, G., & Sinnott, R. (2021). *Chemical engineering design: principles, practice and economics of plant and process design*. Butterworth-Heinemann.
3.	Tucker, G., & Featherstone, S. (2021). *Essentials of thermal processing*. John Wiley & Sons.
4.	Ozaki, Y., Huck, C., Tsuchikawa, S., & Engelsen, S. B. (Eds.). (2020). *Near-infrared spectroscopy: theory, spectral analysis, instrumentation, and applications*. Springer Nature.

Reference(s)

1.	Gehrig, J. S., Sroda, R., & Saccuzzo, D. (2025). *Fundamentals of periodontal instrumentation and advanced root instrumentation*. Jones & Bartlett Learning.
2.	Kress-Rogers, E. (2024). *Handbook of biosensors and electronic noses: medicine, food, and the environment*. CRC Press.
3.	Nielsen, S. S. (2024). Introduction to food analysis. In *Nielsen's Food Analysis* (pp. 3-14). Cham: Springer International Publishing.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Identify and select suitable instruments for measuring key food process parameters.	K3
CO2	Design and analyze control systems for batch and continuous food operations.	K6
CO3	Infer and tune controllers using modern tools and simulation software.	K2
CO4	Interpret IoT and smart sensors for real-time food quality monitoring.	K5
CO5	Demonstrate automation and process control strategies for industrial food processing.	K2

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	2	1	-	2	2	2	-	-	-	2	2	2	1
CO2	3	3	3	3	2	2	2	-	-	-	2	2	2	1
CO3	2	1	-	-	2	2	2	-	-	-	2	2	2	1
CO4	3	3	3	2	2	2	2	-	-	-	2	2	2	1
CO5	2	1	-	-	2	2	2	-	-	-	2	2	2	1
3 – Strong, 2 – Medium, 1 – Low														

FD24404 – SMART OPTIMIZATION APPROACHES IN FOOD SYSTEM								
Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CIAT	ESE	Total
IV	3	0	0	45	3	40	60	100

Course Objective

The goal of this course is for students to,

- Classify the fundamentals of optimization in food systems.
- Explain the role of modern digital tools such as AI, IoT, and simulation in food processing.
- Compare the different optimization techniques used in food quality, safety, and energy efficiency.
- Apply intelligent systems in developing and scaling new food products.
- Appraise hands-on experience in modeling, data analytics, and process simulation.

UNIT I - BASICS OF FOOD SYSTEMS & OPTIMIZATION Overview of unit operations in food processing - Definitions and types of optimizations (linear, nonlinear, multi-objective) - Importance of optimization in reducing waste and improving yield - Introduction to optimization problems in food industry: process, quality, and supply chain - KPIs in food systems: efficiency, cost, quality, sustainability.	**9**
UNIT II - OPTIMIZATION TOOLS IN FOOD PROCESSING Traditional techniques: Linear Programming (LP), Nonlinear Programming (NLP), Integer Programming - Metaheuristic methods: Genetic Algorithms (GA), Particle Swarm Optimization (PSO), Simulated Annealing (SA) - MATLAB, Python (SciPy, PuLP), R, and Excel Solver for modelling - Case studies: optimizing drying time, mixing efficiency, fermentation kinetics.	**9**
UNIT III - SMART SENSORS, IOT & DATA ACQUISITION Sensor types and signal processing (temperature, pH, CO_2, moisture, etc.) - IoT-enabled systems for monitoring processing and storage conditions - Wireless sensor networks, edge computing, and cloud platforms - Use of real-time data for process optimization - Case example: Smart dairy/fruit processing unit.	**9**
UNIT IV - AI, ML & SIMULATION IN FOOD SYSTEMS Introduction to ML models: SVM, Decision Trees, Random Forest, KNN, ANN - Predictive analytics for shelf-life estimation, sensory quality, contamination risks - Digital Twins and	**9**

simulation models for food plant optimization - Model Predictive Control (MPC) in food systems - Simulation software: Simulink, Aspen Plus, COMSOL.	
UNIT V - OPTIMIZATION IN NEW PRODUCT DEVELOPMENT (NPD) Introduction to new product development pipeline in food industries - Formulation optimization: sensory evaluation, ingredient balance, shelf life - Design of Experiments (DoE), Response Surface Methodology (RSM) - Use of AI and ML for trend forecasting, consumer preference prediction - Smart packaging & sustainability aspects in NPD optimization.	**9**
Total Hours	**45**

Textbook(s)	
1.	Talib, F., & Muaz, M. (Eds.). (2024). *Smart Systems: Methodological Approaches and Applications*. CRC Press.
2.	Sehgal, S., Singh, B., & Sharma, V. (Eds.). (2022). *Smart and sustainable food technologies* (pp. 16-17). Springer.
3.	Behnassi, M., Baig, M. B., Sraïri, M. T., Alsheikh, A. A., & Risheh, A. W. A. A. (2022). *Food security and climate-smart food systems*. US: Springer International Publishing.
4.	Florkowski, W. J., Banks, N. H., Shewfelt, R. L., & Prussia, S. E. (Eds.). (2021). *Postharvest handling: a systems approach*. Academic press.
Reference(s)	
1.	**Mujumdar, A.S.** – *Food Drying and Evaporation: Optimization Techniques*
2.	**Scientific journals**: *Trends in Food Science & Technology*, *Journal of Food Engineering*
3.	**Tools**: NPTEL courses, MIT OpenCourseWare, FAO/WHO smart food tech reports

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Explain the core optimization concepts and tools applicable in food systems.	K2
CO2	Apply AI/ML and sensor-based approaches to optimize food processing parameters.	K3
CO3	Utilize simulations and predictive models to improve product quality and process efficiency.	K3
CO4	Design optimized formulations and smart packaging for new product development.	K6
CO5	Improve IoT and cloud systems for real-time monitoring and decision-making in food plants.	K6

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	2	2	2	-	-	-	2	2	2	1
CO2	3	2	1	-	2	2	2	-	-	-	2	2	2	1
CO3	3	2	1	-	2	2	2	-	-	-	2	2	2	1

CO4	3	3	3	3	2	2	2	-	-	-	2	2	2	1
CO5	3	3	3	3	2	2	2	-	-	-	2	2	2	1
3 – Strong, 2 – Medium, 1 – Low														

FD24411 – INSTRUMENTATION FOR FOOD ANALYSIS LABORATORY							
Hours/Week			Total Hours	Credit	Maximum Marks		
L	T	P		C	CIAT	ESE	Total
0	0	4	30	2	40	60	100

Course Objective

The goal of this course is for students to,

- Interpret analytical instruments used in food quality testing.
- Develop practical skills in operating standard food analysis equipment.
- Explain principles behind physical and chemical food property measurements.
- Assess accurate and reproducible analytical data collection.
- Apply instrumentation techniques in evaluating food safety and quality.

List of Experiments

1. Determination of moisture content using hot air oven and moisture analyzer.
2. Measurement of pH and preparation of buffer solutions.
3. Color analysis using colorimeter or UV-Vis spectrophotometer.
4. Protein estimation using UV-Vis spectrophotometry (Biuret/Lowry method).
5. Determination of fat content using Soxhlet extraction.
6. Estimation of reducing sugars using DNS method.
7. Viscosity measurement using viscometer.
8. Texture analysis using texture analyzer.
9. Determination of total soluble solids (TSS) using digital refractometer.
10. Conductivity and salinity testing of food extracts.
11. Analysis of volatile flavor compounds using Gas Chromatography (GC).

On the successful completion of the course, students will be able to,

Course Outcome		**Level**
CO1	Assess the operations and calibrations of key food analysis instruments effectively.	K5
CO2	Analyze moisture, fat, protein, pH, viscosity, and color in food samples.	K4
CO3	Interpret results from spectrophotometric, chromatographic, and rheological methods.	K5
CO4	Apply appropriate techniques for food quality and compositional analysis.	K3
CO5	Demonstrate good laboratory practices and data recording in instrumental analysis.	K2

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	2	2	2	-	-	2	3	3	2
CO2	3	3	2	1	2	2	2	2	-	-	2	3	3	2
CO3	3	2	1	-	2	2	2	2	-	-	2	3	3	2
CO4	3	2	1	-	2	2	2	2	-	-	2	3	3	2
CO5	2	1	-	-	2	2	2	2	-	-	2	3	3	2
3 – Strong, 2 – Medium, 1 – Low														

FD24412 – UNIT OPERATIONS LABORATORY							
Hours/Week			Total Hours	Credit	Maximum Marks		
L	T	P		C	CIAT	ESE	Total
0	0	4	30	2	40	60	100

Course Objective

The goal of this course is for students to,

- Appraise hands-on experience with unit operations commonly used in food processing.
- Develop skills in operating and analyzing equipment used for food processing and separation techniques.
- Utilize the principles of mass and heat transfer in food processing operations.
- Apply theoretical knowledge of unit operations to practical food processing challenges.
- Evaluate and optimize processing techniques for food quality and efficiency.

List of Experiments

1. Study of Drying Kinetics in Food Materials Using a Tray Dryer.
2. Determination of Heat Transfer Coefficients in Food Processing Using a Heat Exchanger.
3. Flow Behavior in Food Liquids Using Venturi and Orifice Meters.
4. Pressure Drop Measurement Across a Packed Bed for Food Dehydration.
5. Solid-Liquid Separation in Fruit Juice Extraction Using a Filter Press.
6. Solid-Liquid Separation Using a Batch Extraction Unit for Nutrient Extraction.
7. Concentration of Fruit Juices Using a Single-Effect Evaporator.
8. Size Reduction and Power Consumption in a Hammer Mill for Food Materials.
9. Study of Sedimentation and Clarification of Suspended Solids in Food Suspensions.
10. Filtration Performance Using a Plate-and-Frame Filter Press for Food Liquids.
11. Evaporation and Concentration of Dairy Products Using a Multiple-Effect Evaporator.

On the successful completion of the course, students will be able to,

Course Outcome		Level
CO1	Demonstrate proficiency in operating various food processing equipment.	K2
CO2	Analyze and interpret data from food processing experiments.	K4
CO3	Apply principles of heat and mass transfer in food processing operations.	K3
CO4	Evaluate the effectiveness of separation processes in food systems.	K5
CO5	Apply laboratory results to optimize food processing techniques for improving efficiency and quality.	K3

Mapping with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2	1	-	-	2	2	2	2	-	-	2	3	3	2
CO2	3	3	2	1	2	2	2	2	-	-	2	3	3	2
CO3	3	2	1	-	2	2	2	2	-	-	2	3	3	2
CO4	3	3	3	2	2	2	2	2	-	-	2	3	3	2
CO5	3	2	1	-	2	2	2	2	-	-	2	3	3	2
3 – Strong, 2 – Medium, 1 – Low														