B. TECH (Food Technology)

2022 Regulations, Curriculum & Syllabi

Stay Ahead

BANNARI AMMAN INSTITUTE OF TECHNOLOGY

An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade

SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA

Ph : 04295-226000/221289 Fax : 04295-226666 E-mail : stayahead@bitsathy.ac.in Web : www.bitsathy.ac.in

CONTENTS

VISION OF THE DEPARTMENT

To develop technically sound human resources who can make a difference in the field of Food Technology and to cater the needs of industry as well as society.

MISSION OF THE DEPARTMENT

- Produce technically well versed and socially responsive professionals who would take up the national and international positions in government and private Food Processing sectors.
- Develop partnerships with industries and communities to share the knowledge and also to train the Food Technologists.
- Produce Food Technologist who can develop novel technologies for better processing, storage and value addition of agricultural products with the ultimate aim to prevent post-harvest losses which in turn helps in increasing the country's economy and also ensures the food security of our nation

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I. Acquire theoretical and practical knowledge of food engineering and technology to become a qualified food process engineer.

II. Apply the skills of food technology in research, industry and entrepreneurship to ensure food safety and nutrition security.

III. Improve the standard of living and economy of the nation through convenience and novel food products with professional ethics.

PROGRAMME OUTCOMES (POs)

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

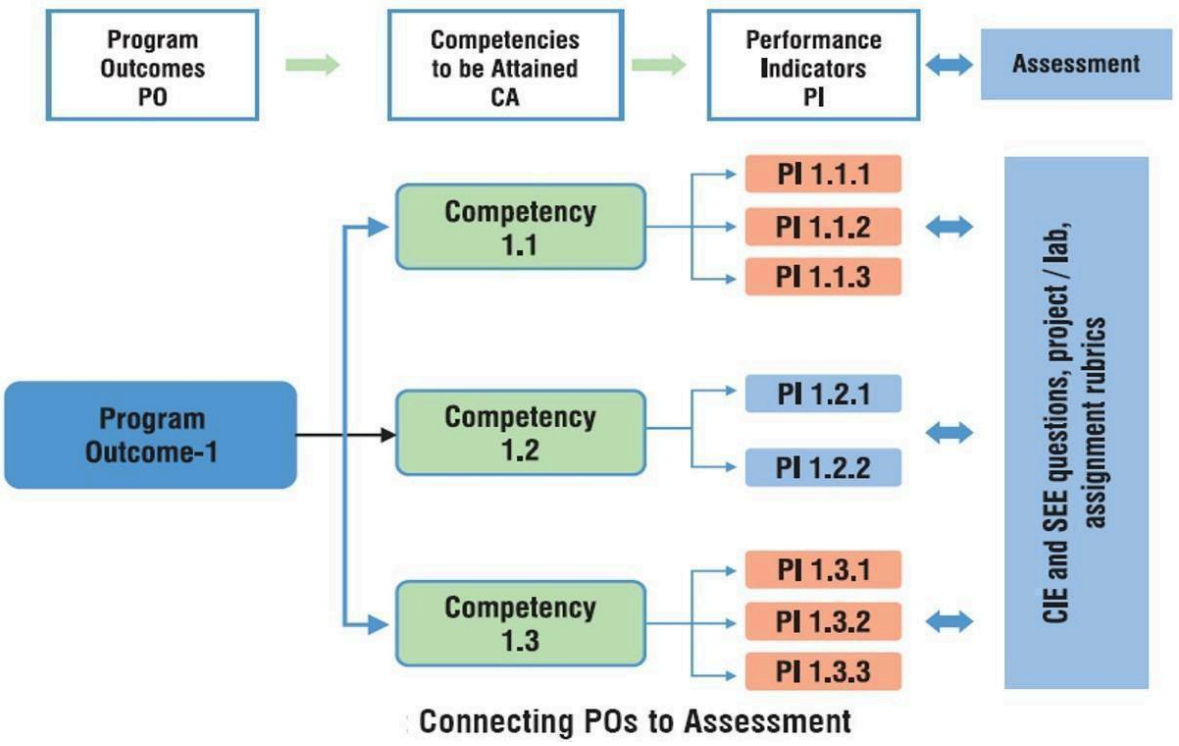
PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
2. Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

MAPPING OF PEOs AND POs

	Program Outcomes											
PEO(s)	1	2	3	4	5	6	7	8	9	10	11	12
I	X	X	X	X							X	
II		X		X	X		X	X				X
III						X	X	X	X	X		

Connectivity chart



Connecting POs to Assessment

FOOD TECHNOLOGY
Minimum Credits to be Earned:163

I SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CA	ES	Total	
22MA101	Engineering Mathematics I	3	1	0	4	4	40	60	100	BS
22PH102	Engineering Physics	2	0	2	3	4	50	50	100	BS
22CH103	Engineering Chemistry I	2	0	2	3	4	50	50	100	BS
22GE001	Fundamentals of Computing	3	0	0	3	4	40	60	100	ES
22HS001	Foundational English	1	0	2	2	3	100	0	100	HSS
22GE003	Basics of Electrical Engineering	2	0	2	3	4	50	50	100	ES
22GE005	Engineering Drawing	1	0	2	2	3	100	0	100	ES
*22HS003	தமிழர் மரபு / Heritage of Tamils	1	0	0	1	1	100	0	100	HSS
Total		**15**	**1**	**10**	**21**	**27**	-	-	-	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CA	ES	Total	
22MA201	Engineering Mathematics II	3	1	0	4	4	40	60	100	BS
22PH202	Electromagnetism and Modern Physics	2	0	2	3	4	50	50	100	BS
22CH203	Engineering Chemistry II	2	0	2	3	4	50	50	100	BS
22GE002	Computational Problem Solving	3	0	0	3	3	40	60	100	ES
22GE004	Basics of Electronics Engineering	2	0	2	3	4	50	50	100	ES
22HS002	Startup Management	1	0	2	2	3	100	0	100	EEC
	Language Elective	1	0	2	2	3	100	0	100	HSS
*22HS006	தமிழரும் தததொழில் நுட்பமும் / Tamils and Technology	1	0	0	1	1	100	0	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	**-**

* The lateral entry students have to complete these courses during III and IV semester.

III SEMESTER

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CA	ES	Total	
22FD301	Numerical Methods and Statistics	3	1	0	4	4	40	60	100	BS
22 FD302	Food Chemistry	3	0	2	4	5	50	50	100	PC

22 FD303	Engineering Thermodynamics	3	1	0	4	5	40	60	100	ES
22FD304	Fluid Mechanics and Machinery	3	0	2	4	4	50	50	100	ES
22 FD305	Food Microbiology	3	0	2	4	5	50	50	100	PC
22HS004	Human Values and Ethics	2	0	0	2	2	100	0	100	HSS
22HS005	Soft skills and Effective Communication	0	0	2	1	2	100	0	100	EEC
Total		**17**	**2**	**10**	**24**	**28**	-	-	-	**-**
IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD401	Sensory Evaluation of Food	3	0	0	3	3	40	60	100	PC
22FD402	Heat and Mass Transfer	3	0	2	4	5	50	50	100	PC
22FD403	Refrigeration and Cold chain Management	3	1	0	4	3	40	60	100	PC
22FD404	Food Processing and Preservation	3	0	2	4	5	50	50	100	PC
22FD405	Unit Operations in Food Processing	3	0	2	4	5	50	50	100	PC
	Professional Elective I	3	0	0	3	3	40	60	100	ES
22HS007	Environmental Science	2	0	0	-	2	100	0	100	HSS
22HS008	Advanced English and Technical Expression	0	0	2	1	2	100	0	100	EEC
Total		**19**	**1**	**8**	**22**	**30**	-	-	-	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours / Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD501	Baking and Confectionery Technology	3	0	2	4	5	50	50	100	PC
22FD502	Fruits and Vegetables Technology	3	0	2	4	5	50	50	100	PC
22FD503	Meat, Poultry and Fish Technology	3	0	0	3	4	40	60	100	PC
22FD504	Dairy Technology	3	0	2	4	4	50	50	100	PC
	Professional Elective II	3	0	0	3	3	40	60	100	PE
	Open Elective	3	0	0	3	3	40	60	100	PE
22FD507	Mini Project I	0	0	2	1	2	100	0	100	EEC
Total		**18**	**0**	**8**	**22**	**26**	-	-	-	**-**
VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD601	Food Processing Plant Design and Layout	3	1	0	4	5	40	60	100	PC
22FD602	Food Equipment Design	3	1	0	4	4	40	60	100	PC
22FD603	Food Instrumentation and Analysis	3	0	2	4	5	50	50	100	PC
	Professional Elective III	3	0	0	3	3	40	60	100	PE
	Professional Elective IV	3	0	0	3	3	40	60	100	PE
	Professional Elective V	3	0	0	3	3	40	60	100	PE
22FD607	Mini Project II	0	0	2	1	2	100	0	100	EEC
Total		**18**	**1**	**6**	**22**	**25**	-	-	-	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD701	Food Laws and Safety Standards	3	0	0	3	4	40	60	100	PC
22FD702	Food Waste Management	3	0	2	4	5	50	50	100	PC
	Professional Elective VI	3	0	0	3	3	40	60	100	PE
	Professional Elective VII	3	0	0	3	3	40	60	100	PE
	Professional Elective VIII	3	0	0	3	3	40	60	100	PE
	Professional Elective IX	3	0	0	3	3	40	60	100	PE
22FD707	Project Work I	0	0	4	2	4	60	40	100	EEC
Total		**18**	**0**	**6**	**21**	**25**	-	-	-	**-**
VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD801	Project Work II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	**-**

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22HS201	Communicative English II	1	0	2	2	3	100	0	100	HSS
22HSH01	Hindi	1	0	2	2	3	100	0	100	HSS
22HSG01	German	1	0	2	2	3	100	0	100	HSS
22HSJ01	Japanese	1	0	2	2	3	100	0	100	HSS
22HSF01	French	1	0	2	2	3	100	0	100	HSS

ELECTIVES

PROFESSIONAL ELECTIVES

Vertical 1 - Innovations in Food Packaging

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FD001	Food Packaging Technology	3	0	0	3	3	40	60	100	PE
22FD002	Food Packaging Design and Development	3	0	0	3	3	40	60	100	PE
22FD003	Diverse Materials in Food Packaging	3	0	0	3	3	40	60	100	PE
22FD004	Emerging Trends and Innovation in Packaging Technology	3	0	0	3	3	40	60	100	PE
22FD005	Packaging Performance Testing and Machinery	3	0	0	3	3	40	60	100	PE
22FD006	Next Generation Packaging	3	0	0	3	3	40	60	100	PE

Vertical 2- Advanced Food Processing

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FD007	Radiation Preservation and Processing of Food Products	3	0	0	3	3	40	60	100	PE
22FD008	Non- Thermal Processing Techniques	3	0	0	3	3	40	60	100	PE
22FD009	Thermal Processing Techniques	3	0	0	3	3	40	60	100	PE
22FD010	Food Sensors	3	0	0	3	3	40	60	100	PE
22FD011	3D Printing of Foods	3	0	0	3	3	40	60	100	PE
22FD012	Application of Nanotechnology and Cryogenics in Food Processing	3	0	0	3	3	40	60	100	PE

Vertical 3- Bakery and Confectionery Technology

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FD013	Traditional Confectioneries	3	0	0	3	3	40	60	100	PE

22FD014	Rheological Properties of Bakery and Confectionery Products	3	0	0	3	3	40	60	100	PE
22FD015	Design of Bakery and Confectionery Equipment	3	0	0	3	3	40	60	100	PE
22FD016	Industrial Production of Baked Goods	3	0	0	3	3	40	60	100	PE
22FD017	Sugar Technology	3	0	0	3	3	40	60	100	PE
22FD018	Bakery Science and Ingredient Technology	3	0	0	3	3	40	60	100	PE

Vertical 4- Spices, Plantation and Herbs Technology

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FD019	Tea and Coffee Processing	3	0	0	3	3	40	60	100	PE
22FD020	Aromatic Spices Processing	3	0	0	3	3	40	60	100	PE
22FD021	Processing of Chocolate and its products	3	0	0	3	3	40	60	100	PE
22FD022	Value added spice products	3	0	0	3	3	40	60	100	PE
22FD023	Processing of Coconut and its Products	3	0	0	3	3	40	60	100	PE
22FD024	Aromatic Herbs Processing	3	0	0	3	3	40	60	100	PE

Vertical 5 - Food Safety and Quality Management

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FD025	National and International Food Laws	3	0	0	3	3	40	60	100	PE
22FD026	Risk analysis	3	0	0	3	3	40	60	100	PE
22FD027	Food Adulteration and its Control	3	0	0	3	3	40	60	100	PE
22FD028	Food Safety Management Systems	3	0	0	3	3	40	60	100	PE
22FD029	Food Supply Chain Management Logistics	3	0	0	3	3	40	60	100	PE
22FD030	Quality Assurance and Quality Control in Food Industry	3	0	0	3	3	40	60	100	PE

Vertical 6- Food Biotechnology										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD031	Microbial Preservation and Processing	3	0	0	3	3	40	60	100	PE
22FD032	Bioprocess Technology	3	0	0	3	3	40	60	100	PE
22FD033	Food allergens and Toxicology	3	0	0	3	3	40	60	100	PE
22FD034	Enzyme Technology	3	0	0	3	3	40	60	100	PE
22FD035	Food Fermentation Technology	3	0	0	3	3	40	60	100	PE
22FD036	Cellular Agriculture	3	0	0	3	3	40	60	100	PE

Vertical 7- Fruit and Vegetable Technology										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FD037	Fruit Science	3	0	0	3	3	40	60	100	PE
22FD038	Post-harvest Management of Fruits and Vegetable	3	0	0	3	3	40	60	100	PE
22FD039	Fruit and Vegetable Processing	3	0	0	3	3	40	60	100	PE
22FD040	Beverage Technology	3	0	0	3	3	40	60	100	PE
22FD041	Value-added products from Fruits and Vegetables	3	0	0	3	3	40	60	100	PE
22FD042	Fruit and Vegetable Waste Management	3	0	0	3	3	40	60	100	PE

HONOURS DEGREE (WITH SPECIALIZATION)										
Vertical 1 - Innovations in Food Packaging										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ES**	**Total**	
22FDH01	Food Packaging Technology	3	0	0	3	3	40	60	100	PE
22FDH02	Food Packaging Design and Development	3	0	0	3	3	40	60	100	PE

22FDH03	Diverse Materials in Food Packaging	3	0	0	3	3	40	60	100	PE
22FDH04	Emerging Trends and Innovation in Packaging Technology	3	0	0	3	3	40	60	100	PE
22FDH05	Packaging Performance Testing and Machinery	3	0	0	3	3	40	60	100	PE
22FDH06	Next Generation Packaging	3	0	0	3	3	40	60	100	PE

MINOR DEGREE (OTHER THAN FD STUDENTS)

Vertical 1 - Innovations in Food Packaging

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CA	ES	Total	
22FDM01	Food Packaging Technology	3	0	0	3	3	40	60	100	PE
22FDM02	Food Packaging Design and Development	3	0	0	3	3	40	60	100	PE
22FDM03	Diverse Materials in Food Packaging	3	0	0	3	3	40	60	100	PE
22FDM04	Emerging Trends and Innovation in Packaging Technology	3	0	0	3	3	40	60	100	PE
22FDM05	Packaging Performance Testing and Machinery	3	0	0	3	3	40	60	100	PE
22FDM06	Next Generation Packaging	3	0	0	3	3	40	60	100	PE

OPEN ELECTIVES

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
22OBT01	Biofuels	3	0	0	3	3	40	60	100	OE
22OPH01	Nanomaterials Science	3	0	0	3	3	40	60	100	OE
22OPH02	Semiconductor Physics and Devices	3	0	0	3	3	40	60	100	OE
22OPH03	Applied Laser Science	3	0	0	3	3	40	60	100	OE
22OPH04	Bio-photonics	3	0	0	3	3	40	60	100	OE
22OPH05	Physics of Soft Matter	3	0	0	3	3	40	60	100	OE
22OCH01	Corrosion Science and Engineering	3	0	0	3	3	40	60	100	OE
22OCH02	Polymer Science	3	0	0	3	3	40	60	100	OE
22OCH03	Energy Storing Devices	3	0	0	3	3	40	60	100	OE

22OMA01	Graph Theory and Combinatorics	3	0	0	3	3	40	60	100	OE
22OGE01	Principles of Management	3	0	0	3	3	40	60	100	OE
22OGE02	Entrepreneurship Development I	3	0	0	3	3	40	60	100	OE
22OGE03	Entrepreneurship Development II	3	0	0	3	3	40	60	100	OE
22OGE04	Nation building: Leadership and Social Responsibility	3	0	0	3	3	40	60	100	OE

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS PER SEMESTER								TOTAL CREDIT	CREDITS in %	Range of Total Credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	10	10	4	-	-	-	-	-	24	15	15%	20%
2	ES	8	6	8	3	-	-	-	-	25	15	15%	20%
3	HSS	2	3	3	-	-	-	-	-	8	5	5%	10%
4	PC	-	-	8	18	15	12	7	-	60	36.8	35%	45%
5	PE	-	-	-	-	6	9	12	-	27	16.5	15%	20%
6	EEC	1	2	1	1	1	1	2	10	19	11.6	5%	10%
Total		21	21	24	22	22	22	21	10	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3											2	
2	2	3												
3	2	3											2	2
4	3	3												
5	1	3												2

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orhtogonality - Canonical form and its nature

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, radius and interval of convergence - Tests of convergence for series of positive terms - comparison test, ratio test

NIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y= abx through least square approximation - Calculus of exponential functions - Exponential series - Characteristics

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables -Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints

Total: 60 Hours

Reference(s)

1. Erwin Kreyszig , Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics ,Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Course Outcomes (COs)

1. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1						2						1
2	2	1						2					2	
3	2	1						2	2					2
4	2	1						2						
5	2	1						2					2	

UNIT I **6 Hours**
CONSERVATION OF ENERGY

Concept of energy - types of energy-conservation of energy. Mechanical energy: - translation - rotation -vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency - resonance

UNIT III **6 Hours**

PROPAGATION OF ENERGY

Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voicere - reflection - refraction-beats

UNIT IV **7 Hours**

EXCHANGE OF ENERGY

Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes

Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale -maximization of entropy

UNIT V **6 Hours**

ENERGY IN MATERIALS

Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

1 **5 Hours**

EXPERIMENT 1

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

2 **5 Hours**

EXPERIMENT 2

Determination of moment of inertia-Torsional pendulum

3 **5 Hours**

EXPERIMENT 3

Determination of thickness of a thin wire using interference of light-Air wedge method

4 **4 Hours**

EXPERIMENT 4

Determination of ac frequency using Meldes apparatus

5 **3 Hours**

EXPERIMENT 5

Determination of thermal conductivity of a bad conductor using Lees disc method

6 **4 Hours**

EXPERIMENT 6

wavelength of ultrasonics in a liquid medium

(ii) velocity of ultrasonic waves in the given liquid

(iii) compressibility of the given liquid using ultrasonic interferometer

7 **4 Hours**

EXPERIMENT 7

Determination of Youngs modulus of a given material- Non uniform bending method

Total: 60 Hours

Reference(s)

1. 1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019.
2. 2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. 3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. 4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. 5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1											2	
2	2	1												
3	2	1												2
4	2	1												
5	2	1											1	

UNIT I **5 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - fusion - hypernova - supernova - dying stars - man-made elements

UNIT II **7 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - types of chemical bonds - bond energy - bond cleavage - activation energy of reactions

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions

UNIT V **6 Hours**

STATES OF MATTER

Solid - liquid - gas - plasma - quantum dots - arrangement of atoms/ions/molecules in different phases

1 **2 Hours**

EXPERIMENT 1

Lab safety rules and guidelines for students - OSHA Guidelines

2 **3 Hours**

EXPERIMENT 2

Estimation of dissolved oxygen content in water sample(s) by Winkler's method

3 **4 Hours**

EXPERIMENT 3

Determination of Fe(II) in a sample using spectrophotometer

4 **3 Hours**

EXPERIMENT 4

Estimation of chromium content in water sample by volumetric analysis

5 **3 Hours**

EXPERIMENT 5

Estimation of chloride present in the given water sample by argentometric method

6 **3 Hours**

EXPERIMENT 6

Conductometric titration of mixture of acids

7 **4 Hours**

EXPERIMENT 7

Estimation of magnesium ions in given solution by EDTA method

8 **4 Hours**

EXPERIMENT 8

Preparation of salt of fatty acid by saponification process

9 **4 Hours**

EXPERIMENT 9

Recrystallization of aspirin from water/ethanol

Total: 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	1										
2	3	3	3	1										
3	2	2	2	1										
4	2	2	2	1										
5	2	2	2	1										

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - its flow, functions and control - communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input-Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed From The Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S.Pressman, "Software Engineering: A Practitioner"s Approach", McGraw Hill International edition, Seventh edition, 2010

22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3		2		
2									2	3		2		
3									2	3		2		
4									2	3		2		
5									2	3		2		

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord-Tenses-Common Errors in verbal communication Be-verbs
Self-Introduction-Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions Paralinguistics/Vocalics- Body Language- Appearance-Eye Contact-Artefacts
Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases - Modified for spontaneity and individuality-Question tags, framing questions including WH-questions-Prepositions-Listening to Ted talks-Listening for specific information

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One word substitution-Adjectives-Similes, Metaphors, Imagery & Idioms -Link words - Inclusive language Narrative Expression- Travelogue and Minutes of Meeting -Verbal analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph completion-Past tense -Using quotation marks

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail- Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs Precision in comprehension, Summary writing, Selective summary-Reading: Active reading- short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis- Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarising information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context Paraphrasing-Sentence Transformation - simple, compound, complex. Sentence substitution-Sentence completion- Interpreting paragraphs

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE003 BASICS OF ELECTRICAL ENGINEERING

2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2	2								2	2	1	3
2	2	2	2	3							3	2	2	2
3	2	2	1	3							2	2	3	2
4	3	2	1	2							2	2	4	3
5	2	2									2	2	5	2

UNIT I **5 Hours**

ELECTRIC CHARGE

Properties of charge, additivity of charges, quantization of charge, conservation of charge , Forces between multiple charges, Electric charge in conductors, Drift of Electrons, Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges, Significance of Electric field line. Electric Dipole and its significance, Continuous charge distribution, Field in infinite long uniform straight conductors, field in uniform charged uniform infinite plane sheet, field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field, magnetic fields in infinitely long straight wire, straight and toroidal solenoids, Magnetic dipole moment of a revolving electron, Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis, Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields, Force on a current carrying conductor in a uniform magnetic field, Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields, Energy storage in magnetic field, Electromagnetic induction, induced emf, Eddy currents. Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

1 **15 Hours**

EXPERIMENT 1

Analyze and design of Electromechanical energy conversion system.

2 **15 Hours**

EXPERIMENT 2

Develop an electrical machine and analyze its performance with supplied input of AC from 0 V to 230 V.

Total: 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22GE005 ENGINEERING DRAWING 1 0 2 2

Course Objectives

- To provide knowledge on fundamentals of engineering drawings and conic sections.
- To impart skill on orthographic projections of points and lines.
- To familiarize on projection of planes and simple solids.
- To provide knowledge on section of solids and development of surfaces of simple solids.
- To impart skill on conversion of isometric view to orthographic projection and vice versa.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

Course Outcomes (COs)

1. Understand the engineering drawing concepts as per industrial standards.
2. Construct orthographic projections of points and lines.
3. Draw the projection of planes and simple solids.
4. Draw the section of solids and development of surfaces.
5. Draw the orthographic projection from isometric view and vice versa.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2							2		2			2	
2	2							2		2			2	
3	1							2		2			2	
4	1							2		2			2	
5	1							2		2			2	

UNIT I 7 Hours

FUNDAMENTALS OF ENGINEERING DRAWING

Definition, standards, drawing tools, drawing sheets, scales, line and its types. Practices on lettering, numbering, dimension of drawings. Construction of conic sections - ellipse, parabola and hyperbola using eccentricity method.

UNIT II 9 Hours

PROJECTION OF POINTS AND LINES

Principles of projection, projection of points in four quadrants, first angle projection of straight lines - perpendicular to one plane, parallel and inclined to both planes.

UNIT III 9 Hours

PROJECTION OF PLANES AND SOLIDS

Projection of simple planes and projection of simple solids - parallel, perpendicular and inclined to one plane using change of position method, inclined to both the planes

UNIT IV **9 Hours**

SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES

Section of Solids - simple position with cutting plane parallel, perpendicular and inclined to one plane with true shape of section. Development of surfaces - simple and truncated solids.

UNIT V **11 Hours**

ORTHOGRAPHIC PROJECTIONS AND ISOMETRIC VIEW

Orthographic projections and isometric view of components used in engineering applications.

Total: 45 Hours

Reference(s)

1. N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishing House Pvt. Limited,2019.
2. K.V. Natarajan, A Text Book of Engineering Graphics, Dhanalakshmi Publishers, 2013.
3. K Venugopal, Engineering Drawing and Graphics, Sixth edition, New Age International, 2013.
4. Basant Agarwal, Mechanical drawing, Tata McGraw-Hill Education, 2013.
5. Engineering Drawing Practice for Schools & Colleges, Bureau of Indian Standards-Sp46, 2013.

22HS003 HERITAGE OF TAMILS **1 0 0 1**

Course Objectives

1. Describe the linguistic diversity in India, highlighting Dravidian languages and their features.
2. Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures.
3. Examine the role of sports and games in promoting cultural values and community bonding.
4. Discuss the education and literacy systems during the Sangam Age and their impact.

5. Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

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

UNIT II **3 Hours**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

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

UNIT III **3 Hours**

FOLK AND MARTIAL ARTS

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

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

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

UNIT V **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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

Total: 15 Hours

Reference(s)

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

22HS003 - தமிழர் மரபு **1 0 0 1**

பாடத்திட்டத்தின் நோக்கம்

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

கற்றலின் விளைவு

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

4. தமிழ் மொழியின் சிறப்புகளை அதன் படைப்பிலக்கியங்கள் மூலம் அறிந்து கொள்ளுதல்.
5. கற்காலம் தொடங்கி, இக்காலம் வரை சிற்பக்கலை அடைந்த வளர்ச்சியை கண்டுகொள்ளல் .
6. தமிழர் தம் வாழ்வில் எங்கனம் இயற்கையை வணங்கி போற்றினர் என்பதை திணை கோட்பாட்டின் வழி தெளிதல்.
7. இந்திய விடுதலை போரில் தமிழர் ஆற்றிய பங்கினை தெரிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம்: **3**

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

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

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

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: **3**

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

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	3											1	
2	2	3												2
3	2	3											1	2
4	3	3											1	2
5	3	3											2	1

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations- Solutions of first order linear ODE: Leibnitzs and method of separation of variables- Cooling/Heating of an object - A falling object- Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations -Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of vector function and geometrical interpretation- Velocity and acceleration - Gradient and its properties- Tangent and normal vectors - Directional derivative- Divergence of a vector field - Curl of a vector field - Projectile motion

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions

Total: 60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B.Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS

2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves

- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Understand the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1							2					
2	2	1							2					
3	2	1							2					
4	2	1												
5	2	1							2					

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field- Electric flux - Electric potential - electrical energy-capacitor-conductors and insulators-Electric dipole and polarization - electric current -voltage sources- resistance

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism- monopoles-magnetic field and force-magnetic field and current distribution-magnetic dipole-magnetic potential energy-inductor- electric and magnetic field comparison

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: basic laws-electromagnetic energy-radiation. Electromagnetic waves: origin, nature and spectrum-visible light Principle of least time- geometrical optics-Human eye - Diffraction - Interference - polarization-LASER

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - simultaneity and time dilation - length contraction - relativistic mass variation. Matter waves - de-Broglie hypothesis - wave nature of particles

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS

Band theory of solids - classification of materials - semiconductors - direct and indirect semiconductor - fermi energy -Intrinsic and extrinsic semiconductor - carrier concentration - electrical conductivity

1 **5 Hours**

EXPERIMENT 1
Determination of V-I characteristics of a solar cell

2 **5 Hours**

EXPERIMENT 2
Determination of Hall voltage of a given specimen by Hall Effect method

3 **5 Hours**

EXPERIMENT 3
Determination of wavelength of a given laser source - Grating method

4 **4 Hours**

EXPERIMENT 4
Determination of particle size using diode laser

5 **3 Hours**

EXPERIMENT 5
Determination of refractive index of a given solid medium and liquid medium

6 **4 Hours**

EXPERIMENT 6
Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

7 **4 Hours**

EXPERIMENT 7
Determination of band gap energy of a given semiconducting material

Total: 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Understand the mechanism of corrosion and suggest a method to control the corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												1
2	2	1											1	2
3	2	1					1							1
4	2	1											2	1
5	2	1											2	2

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - electromotive force - electrical double layer - transport of charge within the cell - cell description - prediction of cell potentials

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - reversible and irreversible cell - charging and discharging reactions in a reversible cell - current challenges in energy storage technologies

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - electromigration - electron transfer in the presence and absence of moisture - galvanic series. Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - activation energy - role of catalyst - homogeneous and heterogeneous catalysis - types

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - variation in properties between isotopes - radioactive decay (alpha, beta and gamma) - half-life period - nuclear reactions - radiocarbon dating

1 **4 Hours**

EXPERIMENT 1

Determination of strength of hydrochloric acid in a given solution using pH meter

2 **4 Hours**

EXPERIMENT 2

Application of calomel electrode to determine the redox potential of Fe(II) solution

3 **4 Hours**

EXPERIMENT 3

Construct an electrochemical cell exhibiting valid output and compare its potential with the given standard cell

4 **5 Hours**

EXPERIMENT 4

Determination of corrosion percentage of iron/steel by weight loss method

5 **4 Hours**

EXPERIMENT 5

Determination of percentage of corrosion inhibition in iron/mild steel using a natural inhibitor

6 **4 Hours**

EXPERIMENT 6

Electroplate copper on the given target object and estimate the amount of copper deposited at cathode

7 **5 Hours**

EXPERIMENT 7

Determination of rate constant of acid catalyzed hydrolysis of ester

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E.McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley &Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017

22GE002 COMPUTATIONAL PROBLEM SOLVING

3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1	2										
2	3	3	3	3										

3	2	2	2	3										
4	2	2	2	2										
5	2	2	2	2										

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - logical sequencing - drawing flowchart - preparing visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database- Data Read & Write in Local Storage, Server Storage and Cloud storage - Database Query Methods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE004 BASICS OF ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To Understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To Analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic Devices.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	3	1									1	
2	3	3	3	2										
3	3	3	3	2									2	
4	3	3	3	2										3
5	3	3	3	1									1	2

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical, Electrical and Electromagnetic means, Signal as Energy Transmission, Complexity in signal transmission (Volume of Information, Distance and Time taken), Limitations of Mechanical Energy Transmission, Electrical and Electromagnetic Signal Transmission, Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics, Overview of Vacuum Tubes, Diode and Triode, Limitations of Vacuum Tubes. Semiconductor Group in Periodic Table, Overview of Semiconductor Materials, Flow of electrical energy through PN Junction Diode, Signal Clipping, Signal Clamping and Signal Multiplication using PN Junction Diode, Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals, Principle of Bipolar Junction Transistor operation, Signal Switching and Amplification using BJT, Limitations of BJT, Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates, PN Junction and BJT as electronic switches, Digital Logic Synthesis using Diode and Transistor: Diode Logic, Resistor Transistor Logic, Diode Transistor Logic, Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode, Variable Capacitance using Varactor Diode, Electrical Energy to Light Energy conversion using Light Emitting Diode, Light to Energy to Electrical Energy conversion using Solar Cell.

1 **4 Hours**

EXPERIMENT 1

Design and Implement a simple device to communicate basic information between two different small distance points
using wired and wireless methods.

2 **6 Hours**

EXPERIMENT 2

Design and Implement different wave shaping Circuits using PN Junction Diodes.

3 **4 Hours**

EXPERIMENT 3

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

4 **4 Hours**

EXPERIMENT 4

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

5 **4 Hours**

EXPERIMENT 5

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

6 **4 Hours**

EXPERIMENT 6

Design and Implement Basic Logic Gates using PN Junction Diodes.

7 **4 Hours**

EXPERIMENT 7

Design and Implement Basic Logic Gates using BJTs.

Total: 60 Hours

Reference(s)

1. Thomas L. Floyd ,Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

22HS002 STARTUP MANAGEMENT 1 0 2 2

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups
- Provide insights on markets and the dynamics of buyer behaviour
- Train to develop prototypes and refine them to a viable market offering

- Support in developing marketing strategies and financial outlay
- Enable to scale up the porotypes to commercial market offering

Programme Outcomes (POs)

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1							1	2	1		1			
2							2	2	1	1	2			
3							3	3	1	2	2			
4							1	3	1	2	2			
5							2	3	2	2	2			

UNIT I **3 Hours**

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods-Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

1 **1 Hours**

EXPERIMENT 1

Analysis of various business sectors

2 **2 Hours**

EXPERIMENT 2

Developing a Design Thinking Output Chart

3 **1 Hours**

EXPERIMENT 3

Creating Buyer Personas

4 **3 Hours**

EXPERIMENT 4

Undertake Market Study to understand market needs and assess market potential

5 **2 Hours**

EXPERIMENT 5

Preparation of Business Model Canvas

6 **15 Hours**

EXPERIMENT 6

Developing Prototypes

7 **2 Hours**

EXPERIMENT 7

Organizing Product Design Sprints

8 **2 Hours**

EXPERIMENT 8

Preparation of Business Plans

9 **2 Hours**

EXPERIMENT 9

Preparation of Pitch Decks

Total: 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015

4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS006 TAMILS AND TECHNOLOGY **1 0 0 1**

Course Objectives

1. Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
2. Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silappathikaram and their cultural significance.
3. Examine ancient knowledge of oceans and its impact on Tamil society.

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.

2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT I **3 Hours**

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II **3 Hours**

DESIGN AND CONSTRUCTION TECHNOLOGY

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

UNIT III **3 Hours**

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.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu 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 Hours

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.

Total: 15 Hours

Reference(s)

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

22HS006 - தமிழரும் தொழில்நுட்பமும் 1 0 0 1

பாடத்திட்டத்தின் நோக்கம்

1. சங்க காலத்தில் வரலாறு மற்றும் கலாச்சார ஆவணங்களின் ஒரு வடிவமாக, மட்பாண்டங்கள் மீதான கிராஃபிட்டியை பகுப்பாய்வு செய்தல்.
2. சிலப்பதிகாரத்தில் கட்டப்பட்ட மேடை கட்டுமானங்களின் விவரங்களையும் அவற்றின் கலாச்சார முக்கியத்துவத்தையும் பகுப்பாய்வு செய்வதன் மூலம், சங்க காலத்தில் மாவீரர் கற்களின் கட்டுமானப் பொருட்கள் மற்றும் வரலாற்று சூழலை ஆராய்தல்.
3. சமுத்திரங்கள் பற்றிய பண்டைய அறிவையும், தமிழ் சமூகத்தில் அதன் தாக்கத்தையும் ஆராய்வது ஆகியவை இப்பாடத்திட்டத்தின் நோக்கம் ஆகும்.

கற்றலின் விளைவு

1. சங்க காலத்தில் நெசவுத் தொழிலின் முக்கியத்துவத்தையும் அதன் கலாச்சார முக்கியத்துவத்தையும் புரிந்து கொள்ளல்.
2. சோழர் கால விவசாய மற்றும் நீர்ப்பாசன நடைமுறைகளில் அணைகள், குளங்கள் மற்றும் மதகுகளின் முக்கியத்துவத்தைப் புரிந்து கொள்ளல்.
3. சங்க காலத்தில் வீட்டுப் பொருட்களில் பயன்படுத்தப்பட்ட கட்டடக்கலை வடிவமைப்புகள் மற்றும் கட்டமைப்பு கட்டுமான முறைகளை ஆராய்தல்.
4. பண்டைய தமிழ் கலாச்சாரத்தில், கப்பல் கட்டும் கலை, கடல் வர்த்தகம் மற்றும் போக்குவரத்தில் அதன் பங்கை ஆராய்தல்.
5. தமிழ் மொழியில் அறிவியல் சொற்களஞ்சியம் மற்றும் சொல்லகராதியின் வளர்ச்சியைக் கண்டறிதல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**

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.

அலகு III உற்பத்தித் தொழில் நுட்பம்: **3**

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.

அலகு IV வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்: **3**

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

அலகு V அறிவியல் தமிழ் மற்றும் கணித்தமிழ்: **3**

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

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

22FD301 NUMERICAL METHOD AND STATISTICS 3 1 0 4

Course Objectives

- Understand the methods to solve polynomial equations and Implement the ideas of numerical interpolation
- Develop enough confidence to solve differential equations numerically
- Summarize and apply the concepts of statistics in solving engineering problems

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Understand the basic concepts of solving equations and able to identify the derivative and integration of functions
2. Acquire the knowledge of solving various types of ordinary and partial differential equations, numerically
3. Comprehend the ideas of basics statistics in engineering
4. Apply the knowledge of testing of hypothesis for small and large samples in engineering problems
5. Interpret the knowledge of design of experiments and control charts in the field of Engineering

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2												
2	1	2												
3	2	3												
4	2	2												
5	2	3												

UNIT I **10 Hours**

NUMERICAL TECHNIQUES FOR SOLVING EQUATIONS, DIFFERENTIATION AND INTEGRATION

Solution of algebraic and transcendental equations - Newton Raphson method - Solution of linear system of equations - Gauss elimination method - Jacobis method for inverse matrices- Eigenvalues of a matrix by Power method -Interpolation - Lagranges interpolation - Approximation of derivatives using interpolation polynomials- Numerical integration using Simpsons rule

UNIT II **9 Hours**

SOLUTION OF ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Solution of ordinary differential equation: Fourth order Runge - Kutta method for solving first order equations - Solution of two-dimensional heat equation: Laplaces and Poissons equations- One dimensional heat flow equation- Solution of One dimensional wave equation

UNIT III **7 Hours**

BASIC STATISTICS

Mean-Median-Mode-Variance and Standard deviation -Covariance - Correlation and Regression

UNIT IV **9 Hours**

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-square and F distributions-Chi -square distributions (test for independent and Goodness of fit)

UNIT V **10 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHARTS

One way and two-way classifications-Completely randomized design-Randomized block design-Latin square design- 2X2 factorial design-Control Charts of Variable and Attributes

Total: 60 Hours

Reference(s)

1. Sankara Rao. K, Numerical Methods for Scientists and Engineers, Third Edition, Eastern Economy Edition, 2009
2. Jain M.K, Iyangar S.R.K and Jain R.K Numerical Methods For Scientific and Engineering Computation New Age International (P) Ltd , New Delhi , 2005.
3. William Navidi, Statistics for Engineers and Scientists, 2nd Edition, Tata Mcgraw Hill, 2008.
4. Richard A Johnson, Miller and Feunds Probability and Statistics for Engineers, 8thEdiion, Phi Learning Private Ltd, 2014.
5. Seymour Lipschuts, Introduction to Probability and Statistics, 1st Ediion, McGraw Hill, 2012.

22FD302 FOOD CHEMISTRY 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Assess the metabolic process of food and recommended dietary allowances of nutrients
2. Apply the structural changes in carbohydrates during processing and predict their physiological effects in the body
3. Analyze the functional and nutritional properties of proteins
4. Evaluate the properties and physico-chemical changes of fats and oil during processing and their industrial importance
5. Justify the importance of vitamins and minerals and their physiological role in the human body

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1	2	2	3	2						2		
2		1	2	2	2	1						2		
3		1	2	2	2							2		
4		1	2	2	2	1						2		
5		1	2	2								2		

UNIT I **9 Hours**

INTRODUCTION TO FOOD COMPONENTS AND IMPORTANCE OF NUTRITION

Nutrients: Sources and functions; Food groups: classification and importance; Metabolism -Digestion, absorption, assimilation and transport of carbohydrates, proteins and fats in human beings; Energy Balance: Basal metabolism- BMR; Body surface area and factors affecting BMR. Water intake and losses; Diet: balanced diet, recommended dietary allowances; Malnutrition

UNIT II **9 Hours**

CARBOHYDRATES IN FOOD

Carbohydrates -Definition, classification, sources, structure, reducing and non-reducing sugars, properties of sugars-sweetness index, caramelization, Maillard reaction. Starch-sources, structure and composition, gelatinization and retrogradation. Modified starches: methods of starch modification; dietary fibers and carbohydrates digestibility

UNIT III **9 Hours**

PROTEINS IN FOOD

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

UNIT IV **9 Hours**

FATS AND OILS IN FOOD

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

UNIT V **9 Hours**

MICRONUTRIENTS, VITAMINS AND MINERALS

Vitamins and Minerals - Classification, Sources, Physiological role and Deficiency disorders, RDA, Losses of vitamins and minerals during processing, restoration and fortification

1 **3 Hours**

EXPERIMENT 1

Identification of edible water based on standards

2 **3 Hours**

EXPERIMENT 2

Proximate analysis of carbonated beverages available in market

3 **6 Hours**

EXPERIMENT 3

Comparison of vitamin C content in Natural extracted fruit juice and other beverages

4 **6 Hours**

EXPERIMENT 4

Compare the protein efficiency of different food product by applying the different estimation method

5 **3 Hours**

EXPERIMENT 5

Identification of starch content in bread and potatoes.

6 **3 Hours**

EXPERIMENT 6
Analysis of fat content in dairy product

7 **6 Hours**

EXPERIMENT 7
Verification of nutritional information in different brand biscuits available in the market.

Total: 75 Hours

Reference(s)

1. Cox, M.M. and Nelson, David L. Lehininger, Principles of Biochemistry. 5thEdition.H.Freeman, 2008
2. Murray, Robert K. et al.,Harper Illustrated Biochemistry, 27B Rth Edition. McGraw-Hill, 2006
3. Satyanarayanan, U. Biochemistry Books and Allied. 2005
4. Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 3rd Revised Edition, Springer-Verlag, 2004
5. H.D.Belitz, W.Grosch,P.Schieberle,Food Chemistry,Springer,2009
6. Vaclavik, V. A. and Christian E. W. Essentials of Food Science. 2nd Edition, Kluwer-Academic, Springer, 2003

22FD303 ENGINEERING THERMODYNAMICS 3 1 0 4

Course Objectives

- To study the fundamentals of thermodynamics and zeroth law
- To provide the knowledge on first law of thermodynamics
- To impart the knowledge on second law of thermodynamics and entropy
- To study the thermodynamic properties of pure substances and its phase change processes
- To learn about gas power cycles and properties of gas mixtures

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Exemplify the basic concepts and zeroth law of thermodynamics
2. Apply the first law of thermodynamics to closed and open systems
3. Solve the problems related to cycles and cyclic devices using second law of thermodynamics
4. Determine the thermodynamic properties of pure substances and its phase change processes
5. Evaluate the air standard performance of heat engines and properties of gas mixtures

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3										3		-
2	3	3					1				2	3	-	-

3	3	3					2					3		-
4	3	3			1		2				2	3	-	-
5	3	3	2	1	1	2	2					2	3	-

UNIT I **8 Hours**

INTRODUCTION AND ZEROTH LAW OF THERMODYNAMICS

Macroscopic and Microscopic approaches, energy, heat, work. Thermodynamic system Types, properties, functions, states, processes and cycle. Zeroth law of thermodynamics temperature scale, perfect gas scale.

UNIT II **8 Hours**

FIRST LAW OF THERMODYNAMICS

First law of thermodynamics, Application of first law - Closed systems and Open systems, Thermodynamic processes in closed systems, Steady state flow processes in open systems.

UNIT III **9 Hours**

SECOND LAW OF THERMODYNAMICS

Limitations of first law of thermodynamics, Second law of thermodynamics - Kelvin - Planck and Clausius statements, Reversible and irreversible processes, Carnot theorem, Carnot engine, Clausius inequality, Entropy, Availability and irreversibility. Heat Engine, heat pump and refrigerator

UNIT IV **10 Hours**

PROPERTIES OF PURE SUBSTANCES

Thermodynamic properties of fluids. Pure substance - Phases - Phase change processes, Steam tables and Property diagrams - (P-V), (P-T), (T-V), (T-S) and (h-s) diagrams. Ideal gas equation, Van derWaals equation and compressibility chart.

UNIT V **10 Hours**

GAS MIXTURES AND GAS POWER CYCLES

Thermodynamics and properties of ideal gas mixture and perfect gas mixture - Dalton"s law of partial pressure, Amagat"s law. Psychrometric properties and processes - Psychrometric chart. Air standard cycles Otto, Diesel and Dual cycles- mean effective pressure and air standard efficiency

Total: 60 Hours

Reference(s)

1. Y. Cengel and Boles, Thermodynamics - An Engineering Approach, Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2019.
2. P.K. Nag, Engineering Thermodynamics,Tata McGraw Hill Publishing Company Pvt. Ltd, New Delhi, 2018.
3. J.P.Holman, Thermodynamics, Tata McGraw Hill Publishing Company Pvt Ltd., New Delhi,2016.
4. R.K. Rajput, Engineering Thermodynamics, Laxmi Publications Pvt.Ltd., New Delhi, 2017

22FD304 FLUID MECHANICS AND MACHINERY 3 0 2 4

Course Objectives

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

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Explain the fundamental properties of fluids and methods of pressure measurement in fluid statics
2. Infer fundamentals of fluid kinematics and dynamics and their applications in hydraulic experiments
3. Apply the concept of the boundary layer, Dimensional analysis, and Modal analysis to the fluid structures
4. Assess the performance of a model by dimensional analysis and similitude
5. Compute the efficiency and performance of pumps and turbines

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3		2					2					3
2	3	3		2					2					3
3	3	2		2					2					3
4	2	2		2	1				2					3
5	2	2		2					2					3

UNIT I **9 Hours**

FLUID PROPERTIES AND FLUID STATICS

Concept of Continuum, Properties of Fluid, Classification of fluids, Types of fluid flow Streamline, Streamlines, and path line, Pascals Law and Hydrostatic Law, Pressure and its variation in a static Fluid, Measurement of fluid pressure Manometers, Buoyancy and meta-Centre, Stability analysis and applications

UNIT II **8 Hours**

FLUID KINEMATICS AND DYNAMICS

Continuity equation, Velocity Potential and Stream function, Bernoullis equation, and its applications, Impulse-Momentum principle , Impact of Jet , Velocity triangle

UNIT III **9 Hours**

FLOW THROUGH PIPES AND CHANNELS

Laminar and turbulent flows in circular pipes, Major and Minor losses in pipes, Darcy Weisbach equation, Hagen Poiseuille equation,Multi reservoir problems, pipe network design, Types of open Channel flows, Measurement of discharge in open channels, Notches,Most economical channel section.

UNIT IV **9 Hours**

DIMENSIONAL ANALYSIS AND MODEL TESTING

Buckinghams pitheorem and Application of theorem in fluid flow Reynolds, Froude, and Mach number and their applications in model testing, Boundary layer thickness, Momentum integral equation, Drag and lift, Separation of the boundary layer, and Methods of preventing the boundary layer separation

UNIT V **10 Hours**

HYDRAULIC MACHINES

Centrifugal pumps, Work done, Head developed , Pump output and Efficiencies ,priming - minimum starting speed, performance of multistage pumps, Cavitation, methods of prevention, Pump characteristics, Classification of hydraulic turbines, Pelton wheel, Francis turbine, Kaplan and turbines,Specific speed,Performance characteristics, Selection of turbines, Turbine efficiencies

1 **6 Hours**

EXPERIMENT 1

Find the coefficient of discharge by suitable device that is most accurate to measure the fuel and air distribution in the carburetor of an IC engine in a two wheeler Also, in Pasteurization and Sterilization process. Discuss the effects of the Reynolds number and friction factor in relation to the rate of flow.

2 **3 Hours**

EXPERIMENT 2

Analyze the friction factor of various pipes in a distribution of a water supply for domestic applications.

3 **3 Hours**

EXPERIMENT 3

Determine the coefficient of discharge by suitable device used to monitor and control the flow of water and chemicals in water treatment plants.

4 **3 Hours**

EXPERIMENT4

Analyze the Lift and drag force of an aerofoil design used in a windmill for power generation.

5 **3 Hours**

EXPERIMENT 5

Conduct the performance test of a suitable turbine that is used to extract energy from waterfalls whose water drops down from a height of about 500 m to generate power in Hydropower station.

6 **6 Hours**

EXPERIMENT 6

Conduct the test from which electricity is to be generated has its reservoir fully filled up during the rainy season and the level drops down during summer. A turbine has to be put up such that it can accommodate both cases in a hydropower station.

7 **6 Hours**

EXPERIMENT 7

Determine the efficiency of a pump to pump water to a very high elevation, say >300 ft, and high viscous fluid used for an irrigation and Chocolate Industry.

Total: 75 Hours

Reference(s)

1. Yunus A Cengel, and John M Cimbala, Fluid Mechanics, Third edition, Mc Graw Hill Education (India) Pvt Ltd, 2014
2. Dr R.K. Bansal , A textbook of Fluid Mechanics and Hydraulic Machines, Tenth Edition, LaxmiPublications, New Delhi, 2018
3. Frank M White, Fluid Mechanics, McGraw Hill Publishing Company Ltd, New Delhi, 8th Edition 2017
4. R C Hibbler, Fluid Mechanics, Pearson, First edition, 2017
5. S K Som and G Biswas, Introduction to Fluid Machines, 3rd Edition, McGraw-Hill Education 2017
6. https://nptel.ac.in/courses/112105183

22FD305 FOOD MICROBIOLOGY 3 0 2 4

Course Objectives

- Provide an idea about the general principles of food microbiology.
- Explain the interactions between microorganisms and food and factors influencing their growth and survival.
- Acquire knowledge about pathogens causing food borne infections and their detection methods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Classify the microorganism and identify the microorganism associated with foods
2. Analyse the microorganism responsible for spoilage of foods and its assessments
3. Apply the preservation methods to control the spoilage and assess the microbial growth in foods
4. Analyze the importance of microorganism in food fermentation and fermented products
5. Assess the cause for food borne illness and Understand the quality control for safety of foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1			3		2								
2	1			2		3								
3	2			2	2	3								
4	2			2	1	1								
5	1			2	2	3								

UNIT I **9 Hours**

MICROBES IN CEREALS, FRUITS AND VEGETABLES

Microbiology of cereal and cereal products, Microbiology of fruits and vegetables and canned foods, Microbiology of sugar and sugar products and salts and spices

UNIT II **9 Hours**

MICROBES IN MILK, MEAT, FISH AND POULTRY

Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods

UNIT III **9 Hours**

MICROBES IN FOOD FERMENTATIONS

Microbes of importance in food fermentations, Homo & hetero-fermentative bacteria,yeasts & fungi; Biochemistry of fermentations - pathways involved, Lactic acid bacteria fermentation and starter

cultures, Alcoholic fermentations -Yeast fermentations - characteristics and strain selection, Fungal fermentations. Microbes associated with typical food fermentations- yoghurt, cheese, fermented milks, breads, idly, soy products, fermented vegetables and meats.

UNIT IV **9 Hours**

CONTROL OF MICROBES IN FOODS

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

UNIT V **9 Hours**

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. botulinum & Salmonella, Listeria monocytogenes Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

1 **4 Hours**

EXPERIMENT 1

Preparation and sterilization of agar and broth

2 **2 Hours**

EXPERIMENT 2

Analyze the cell morphology and size of saccharomyces under microscope

3 **4 Hours**

EXPERIMENT 3

Analyze the bacterial cell morphology and size present in cheese.

4 **2 Hours**

EXPERIMENT 4

Analyze the nature of microbe in dairy products

5 **4 Hours**

EXPERIMENT 5

Prepare the media for the growth of Yeast and mold.

6 **4 Hours**

EXPERIMENT 6

Prepare the milk sample with serial dilution of 10^-9

7 **6 Hours**

EXPERIMENT 7

Identification of microbial growth in packaged curd and home made curd by different plating methods.

8 **4 Hours**

EXPERIMENT 8

Isolate the pure culture from fermented fruit juice

Total: 75 Hours

Reference(s)

1. Banwart, G.J., Basic Food Microbiology, 2nd Edition. CBS Publishers, 1998.
2. Vijaya Ramesh. Food Microbiology. MJP Publishers, Chennai, 2007.
3. Jay, J.M. Modern Food Microbiology. 4th Edition. CBS Publishers, 2003
4. Adams, M.R. and M.O. Moss. Food Microbiology. New Age International, 2002
5. Khetarpaul, Neelam. Food Microbiology, Daya Publishing House, 2006.

22HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1								3	2	1				
2								3	2	1				
3								3	2	1				
4								3	2	1				
5								3	2	1				

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century - Understanding the theory of basic human values and ethics -Openness to change -Self enhancement -Conservation -Self transcendence - Schwartz Value Survey: Self-Assessment

UNIT II **6 Hours**

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity-Freedom-Justice-Honesty-Truthfulness-Responsibility-Compassion

UNIT III **6 Hours**

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations- Understanding and living in harmony at various levels of life-Embracing self-love and wellness-Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence.
Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature- Holistic perception of harmony at all levels of existence-Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin. 2011.
2. Gupta, N. L. Human Values For The 21St Century. India: Anmol Publications Pvt. Limited. 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing.2017.
4. Universal Human Values. (n.p.): Booksclinic Publishing. 2023.
5. A Textbook on Professional Ethics And Human Values. India: New Age International (P) Limited.2007.

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION

0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input.
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints.
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT – I - SELF-EXPRESSION **10 Hours**

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives - Discourse markers – Interjections - Decision making - Synthesis - Higher order thinking Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT – II - CREATIVE EXPRESSION **10 Hours**

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced

UNIT – III - FORMAL EXPRESSION **10 Hours**

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Total: 30 Hours

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, BarunK.Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011

22FD401 SENSORY EVALUATION OF FOOD 3 0 0 3

Course Objectives

- Understand the influence of taste, odour and colour perception on sensory quality
- Apply the principles of sensory evaluation methodologies.
- Evaluate the sensory quality of foods using instruments

Programme Outcomes (POs)

c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. To assess the perception of senses by human sensory organs
2. To apply the sensory principles and practices to establish sensory panel and facilities
3. To choose the appropriate sensory evaluation tests related to the quality of foods
4. To analyze the sensory quality of foods using instruments
5. To evaluate the sensory evaluation by applying basic statistical concepts.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1					1	1				1		3		
2					3			2	3	3	2			
3			1	3	3				2	3	3			
4			3	1	3			1						
5				3	1	3		1			1			

UNIT I **9 Hours**

HUMAN SENSES - ANATOMY, PHYSIOLOGY AND PERCEPTION

Aim of sensory evaluation and Applications. Sensory properties and human senses. Importance of Taste, odour, Colour and Texture. Structure and physiology of taste organs - tongue, papillae, taste buds, salivary glands. Mechanism of taste perception- Chemical dimensions of basic tastes- sweet, salt, sour, bitter and umami. olfactory organs and receptors - physiology of odour perception and colour perception Texture classification and texture perception.

UNIT II **9 Hours**

SENSORY PANELS AND TESTING FACILITIES

Establishing sensory panels - Types of panels (Trained panel, discriminative and communicative panel). Selection, training and performance monitoring. Factors influencing sensory verdicts. Response Errors - Types and Steps to reduce the errors. Designing Sensory Testing Facilities. Sampling, preparation and presentation of samples. Panel Measurement scales.

UNIT III **9 Hours**

METHODS OF SENSORY EVALUATION

Methodology for sensory evaluation: Consumer oriented tests and Product Oriented tests. Consumer oriented tests- Preference test, Acceptance test, Hedonic test. Product Oriented tests - Threshold tests; Discriminative test - paired comparison, Duo-trio, triangle; Ranking, Sensitivity Test, Descriptive test - flavor profiling, texture profiling, ratio scaling, quantitative descriptive analysis.

UNIT IV **9 Hours**

INSTRUMENTATION IN SENSORY EVALUATION

Need for Instrumentation in sensory evaluation. Colour Measurement -spectrophotometry, colorimetry, Munsell colour system, CIE colour system, Hunter colour system, Electronic eye (IRIS). Texture measurement - Basic rheological instruments, Texture analyzer. Taste measurement- E-tongue. Odour measurement- E nose, GC - olfactory.

UNIT V **9 Hours**

STATISTICAL ANALYSIS OF SENSORY EVALUATION

Conducting a sensory study. Sensory evaluation of foods and statistical analysis: Hypothesis testing and sensory inference, variation of T Test, Nonparametric and binomial based Statistical methods, Chi square test, analysis of variation, Correlation regression.

Total: 45 Hours

Reference(s)

1. Lyon, D.H., Francombe, M.A., Hasdell, T.A., Lawson, K. (eds), Guidelines for Sensory Analysis in Food Product Development and Quality Control. Chapman and Hall, London, 1992.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation. Academic Press, New York, 1965.
3. Martens, M.; Dalen, G.A.; Russwurm, H. (eds): Flavour Science and Technology. John Wiley and Sons, Chichester, 1987.
4. Moskowitz, H.R. (eds), Food Texture: Instrumental and Sensory Measurement. Marcel Dekker Inc. New York, 1987
5. Rao E. S.. Food Quality Evaluation, Variety Books. 2013.
6. B. M. Watts, G. L. Ylimaki, L. E. Jeffery, L. G. Elias, Basic Sensory Methods For Food Evaluation, 1989

22FD402 HEAT AND MASS TRANSFER 3 0 2 4

Course Objectives

- To familiarize conduction heat transfer mechanisms
- To expose the mechanisms of free and forced convection
- To develop the shape factor algebra for black body radiation and grey body radiation
- To demonstrate the phase change heat transfer and determine the performance of heat exchanging devices
- To infer diffusion and convective mass transfer

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyses complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
n. To improvise better ways to minimize the crop loss from field damage during harvesting, sorting, processing and packaging

Course Outcomes (COs)

1. Apply the heat conduction equation to compute the rate of heat transfer in one and two - dimensional systems and composite systems
2. Assess the convection phenomena and determine the heat transfer rate in free and forced convection
3. Determine the heat transfer rate in radiation and Compare the thermal performance of heat exchangers using LMTD or NTU approach
4. Execute mass transfer rate in diffusion mass transfer applications
5. Evaluate convective mass transfer process and apply mass transfer principles in food and bioprocessing

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1		2							3	
2	2	3	2	2	1		2							3	
3	3	3	2	2	-		2							3	
4	2	3	2	2	-		2							3	
5	2	3	2	2	-		2							3	

UNIT I **8 Hours**

CONDUCTION

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

UNIT II **8 Hours**

CONVECTION

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

UNIT III **11 Hours**

RADIATION AND HEAT EXCHANGERS

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

UNIT IV **10 Hours**

INTRODUCTION TO MASS TRANSFER

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

UNIT V **8 Hours**

CONVECTIVE MASS TRANSFER

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

1 **3 Hours**

EXPERIMENT 1

Determination of thermal conductivity for one dimensional steady state conduction

2 **3 Hours**

EXPERIMENT 2

Determination of heat transfer co-efficient by unsteady heat transfer

3 **3 Hours**

EXPERIMENT 3

Determination of heat transfer co-efficient by natural convection

4 **3 Hours**

EXPERIMENT 4

Determination of heat transfer co-efficient by forced convection

5 **3 Hours**

EXPERIMENT 5

Determination of Stefan-Boltzmann constant

6 **3 Hours**

EXPERIMENT 6

Determination of emissivity using emissivity apparatus

7 **3 Hours**

EXPERIMENT 7

Determination of overall heat transfer for film wise and drop wise condensation

8 **3 Hours**

EXPERIMENT 8

Determination of overall heat transfer co-efficient for a parallel and counterflow heat exchanger

9 **3 Hours**

EXPERIMENT 9

Experimentation on mass transfer

10 **3 Hours**

EXPERIMENT 10

Determination of overall heat transfer co-efficient for a fluidized bed heat transfer

Total: 75 Hours

Reference(s)

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

22FD403 REFRIGERATION AND COLD CHAIN MANAGEMENT

2 1 0 3

Course Objectives

- Learn the principles and the components involved in domestic and commercial refrigeration systems.
- Impart knowledge on application of Refrigeration & Air conditioning systems in food industries.
- Provide knowledge on handling and transport of food materials by ensuring the superior quality.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Select appropriate components of the refrigeration unit and analyze the effect of different refrigerants on environment
2. Differentiate various refrigeration cycles and its applicability
3. Apply knowledge of psychrometry for air conditioning & various food processing operations
4. Apply the knowledge of refrigeration and air conditioning in persevering foods using domestic and industrial refrigeration systems
5. Choose appropriate refrigerated transport facilities for ensuring the product quality

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	3		2			1							
2	3						1	1						
3	2		2	1			1							
4	2	1	1	1		1		1						
5	3	1	3			1			1					

UNIT I **10 Hours**

REFRIGERATION PRINCIPLES AND COMPONENTS

Refrigeration-principles- refrigeration effect-coefficient of performance-units of refrigeration-Refrigeration components-compressor-classification-principle and working - Condensers-types-construction, principle and working. Evaporators-types-principle and working. Expansion device-types construction, principle and working. Refrigerants-properies-classification comparison and advantages-chloroform carbon (CFC) refrigerants-effect on environmental pollution-alternates refrigerants.

UNIT II **9 Hours**

VAPOUR COMPRESSION AND VAPOUR ABSORPTION CYCLE

Simple vapour compression cycle-T-S diagram-p-h chart- vapour compression system-different types-vapour absorption cycle-simple and practical vapour absorption system-advantages-ideal vapour absorption system- Electrolux Refrigerator-Lithium bromide refrigeration-construction and principles

UNIT III **9 Hours**

PSYCHROMETRY

Psychrometry-terms-psychrometric chart-sensible heating-sensible cooling process-by-pass factor-humidification-dehumidification-sensible heat factor-evaporative cooling-cooling and dehumidification-cooling and humidification process-heating and dehumidification- heating and humidification-adiabatic mixing of air streams

UNIT IV **9 Hours**

AIR CONDITIONING SYSTEM

Air conditioning systems-equipment used-classification-comfort and Industrial air conditioning system-winter, summer and year- round air conditioning system- unitary and central air conditioning system-application of refrigeration and air conditioning-domestic refrigerator and freezer-refrigerated trucks-ice manufacture-cold storage-freeze drying.

UNIT V **8 Hours**

COLD CHAIN MANAGEMENT

Cold chain, Refrigerated Transport-Refrigerated Container trucks, Handling and Distribution, Traceability and barcode. Product Temperature and Moisture monitoring

Total: 60 Hours

Reference(s)

1. C. P. Arora, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 2002
2. R.S. Khurmi and J. K. Gupta, A textbook of Refrigeration and Air Conditioning, Eurasia Publishing housing (P) Ltd, New Delhi, 2002
3. Manohar Prasad, Refrigeration and Air conditioning, New Age International (P) Ltd, New Delhi, 1999
4. W. F. Stoecker, and J. W. Jones, Refrigeration and Air Conditioning, Tata McGraw Hill, New Delhi, 1986
5. Roy J. Dossat, Principles of Refrigeration, Pearson Education Asia, 4th edition, 2001
6. S. C. Arora and S. Domkundwar, A course in Refrigeration and Air conditioning, DhanpatRai (P) Ltd., New Delhi, 1997

22FD404 FOOD PROCESSING AND PRESERVATION

3 0 2 4

Course Objectives

- Understand the principles of food processing and their impact on the shelf life and quality of food materials and products
- Learn various methods of food processing viz., drying, milling, freezing, thermal treatments etc.
- Introduce novel food processing techniques

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply different methods of high and low temperature processing techniques over raw foods
2. Understand and apply the suitable dryers to different food to increase the shelf life
3. Analyze the shelf life of foods processed and preserved by natural and chemical agents
4. Understand the operations and features of different non-thermal processing techniques
5. Apply the principle of advanced novel techniques in food processing industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2									1	
2	2	2		2										1
3	2	2												1
4	2	2											1	
5	2	2	2						2				1	

UNIT I **10 Hours**

HIGH AND LOW TEMPERATURE PROCESSING OF FOODS

Methods of applying heat to food -: Pasteurization (Definition, Time-Temperature Combination, Equipment), Sterilization (Definition, Time-Temperature Combination, Equipment), Blanching (Definition, Time-Temperature Combination, Equipment, Adequacy in blanching). Methods of low temperature preservation- Chilling. Freezing, Freeze Drying, Freeze Concentration - Theory and Principles.

UNIT II **10 Hours**

DRYING, DEHYDRATION AND EXTRUSION

Definition, free and bound moisture, Water activity - sorption behavior of foods - water activity and food stability - Relationship between water activity and moisture - Equilibrium moisture content; Drying - types of dryers. Dehydration - Osmotic dehydration (theory and principles); Extrusion cooking - principles and types of extruders - single and double screw extruder- construction and working; Effect of different parameters - quality of the extruded products.

UNIT III **10 Hours**

PROCESSING AND PRESERVATION OF FOODS BY CHEMICALS

Food preservation by the application of sugar, salt, acid (Principles - mechanism- antimicrobial activity); Preservation by chemicals- type of chemical preservatives- Sulphur dioxide, benzoic acid, etc.; use of other chemicals like acidulant, antioxidants, mold inhibitors, antibodies, etc. Factors affecting antimicrobial activity of preservatives.

UNIT IV **7 Hours**

NON THERMAL PROCESSING

Food Irradiation - High Pressure Processing- Cold plasma- Supercritical-Pulsed electric field processing-UV treatment and Ultrasound - Theory and Principles - effect on microorganisms- Application in Processing of foods.

UNIT V **8 Hours**

NOVEL METHODS OF FOOD PROCESSING

High hydrostatic pressure; Hydrodynamic cavitation Ozone treatment, dielectric heating-microwave, radio frequency, ohmics and infrared heating theory, equipment, applications and effect on foods. Hurdle technology and Nano-technology-principle - application in food processing.

1 **2 Hours**

EXPERIMENT 1

Determination of textural characteristics of foods

2 **4 Hours**

EXPERIMENT 2

Determination of flow behavior of Newtonian and Non-Newtonian fluids

3 **4 Hours**

EXPERIMENT 3

Determination of Thermal Death Time

4 **2 Hours**

EXPERIMENT 4

Determination of Water activity of processed food products

5 **2 Hours**

EXPERIMENT 5

Determination of drying rate of fruits and vegetables in Tray dryer

6 **2 Hours**

EXPERIMENT 6

Determination of color characteristics of curry leaves during Fluidized bed dryer

7 **4 Hours**

EXPERIMENT 7

Determination of textural characteristics by Extrusion cooking

8 **2 Hours**

EXPERIMENT 8

Retention of ascorbic acid during Microwave drying of leafy vegetable

9 **2 Hours**

EXPERIMENT 9

Dehydration and rehydration of vegetables in rotary dryer

10 **2 Hours**

EXPERIMENT 10

Determination of freezing point of food materials

11 **2 Hours**

EXPERIMENT 11

Effect of UV treatment on microbial quality of liquid foods

12 **2 Hours**

EXPERIMENT 12

Effect of ohmic heating on microbial quality of liquid foods

Total: 75 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Da-Wen Sun, Emerging Technologies for food processing, 2nd Edition, Academic Press, 2014.
3. 3.R.L. Earle, Unit Operations in Food Processing, Pergamon Press, New York, 1989.
4. Dennis R. Heldman and R. Paul Singh, Introduction to food engineering, Fourth edition, CRC Press, 2006.
5. Howard Q. Zhang, Gustavo V. Barbosa-Canovas, V.M.Balasubramaniam, C. Patrick Dunne, Daniel F.Farkas and James T.C.Yuan. Nonthermal processing Technologies for food, IFT Press, 2011.
6. Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Pilar Cano, Novel Food Processing Technologies, CRC Press,1stEdition,2

22FD405 UNIT OPERATIONS IN FOOD PROCESSING

3 0 2 4

Course Objectives

- Impart knowledge on different unit operations and its significance in food Industry.
- Understand problems related to food processing and ability to solve.
- Familiarize with operational skill of equipment and imparting knowledge on entrepreneurship.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the principle and operation of different types of evaporators and explain the drying of principles.
2. Assess the suitable process technology such as sedimentation, filtration, cyclone and membrane for separation of different kind of particles present in foods.
3. Differentiate the operation of different kind of mixing and size reduction equipment
4. Implement the leaching and extraction techniques to transform raw materials into value added products
5. Apply the mechanism of crystallization and distillation process in food industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		1									1
2	1		2				2							1
3	2		1											1
4	2				1	2								2
5	2				2								1	

UNIT I **8 Hours**

DRYING AND EVAPORATION

Unit operations in food processing - Drying - principles, theory of drying, equilibrium moisture content, methods of moisture determination and source of heat. Evaporation - definition - single and

multiple effect evaporation-types, application and performances of evaporators and total mass balance and common mass balance, types of Feed

UNIT II **10 Hours**

MECHANICAL AND MEMBRANE SEPARATION

Velocity of particles moving in a fluid- terminal velocity, drag coefficient. Sedimentation, Stokes"" law, sedimentation equipment, flotation, sedimentation of particles in a gas, settling under combined forces. Centrifugal Separation, centrifuge equipment. Filtration, filter cake resistance, constant - rate filtration, constant - pressure filtration, filtration graph. Filtration equipment, plate and frame filter press, rotary filters, centrifugal filters, air filters. Air Separators and Sieving: Cyclones - optimum shape efficiency, impingement separators, classifiers, rates of throughput, standard sieve sizes, cumulative analysis, particle size analysis, industrial sieves. Membrane Separation: osmotic pressure, ultra filtration, reverse osmosis, rate of flow through membranes.

UNIT III **9 Hours**

MIXING AND SIZE REDUCTION

Mixing - theory of solid and liquid mixing- equipment - effect on foods. Size reduction - grinding and cutting - principles of comminuting - characteristics of comminuted products - particle size distribution in comminuted products - energy and power requirements in comminuting - crushing efficiency - Rittinger's, Bond"s and Kick's laws for crushing-size reduction equipment - crushers - jaw crusher, gyratory crusher-crushing rolls - grinders -hammer mills - rolling compression mills - attrition, rod, ball and tube mills - construction and operation.

UNIT IV **9 Hours**

EXTRACTION AND LEACHING

Extraction process, rate of extraction, stage-equilibrium extraction, solvent extraction, supercritical fluid extraction, extraction equipment. Leaching: Principles of continuous leaching, counter-current leaching, and leaching equipment,Steady state operations - thickeners,continuous Countercurrent decantation. Leaching of vegetable seeds - Rotocel extractor, Kennedy Extractor

UNIT V **9 Hours**

CRYSTALLIZATION, DISTILLATION

Crystallization - rate of crystal growth - equilibrium crystallization-crystallization equipment - classification - construction and operation-tank, agitated batch, Swenson-Walker vacuum crystallizers-Distillation: Distillation process - binary mixtures - flash and differential distillation-steam distillation - theory - consumption - continuous distillation with rectification - vacuum distillation - batch and fractional distillation - operation and process - advantages and limitations-distillation equipment -construction and operation - factors influencing the operation.

1 **2 Hours**

EXPERIMENT 1

Determination of economy and thermal efficiency of evaporator

2 **3 Hours**

EXPERIMENT 2

Solving problems on single effect evaporator

3 **2 Hours**

EXPERIMENT 3

Solving problems on multiple effect evaporators

4 **2 Hours**

EXPERIMENT 4

Determination of separation efficiency of centrifugal separator

5 **3 Hours**

EXPERIMENT 5

Determination of collection efficiency in cyclone separator

6 **2 Hours**

EXPERIMENT 6

Determination of efficiency of liquid solid separation by filtration

7 **2 Hours**

EXPERIMENT 7

Determination of particle size of granular foods by sieve analysis

8 **2 Hours**

EXPERIMENT 8

Performance evaluation of a sieve

9 **2 Hours**

EXPERIMENT 9

Determination of performance characteristics in size reduction using the burr mill

10 **2 Hours**

EXPERIMENT 10

Determination of energy requirement in size reduction using ball mill

11 **2 Hours**

EXPERIMENT 11

Determination of energy requirement in size reduction using hammer mill

12 **2 Hours**

EXPERIMENT 12

Performance evaluation of pin mill

13 **0 Hours**

EXPERIMENT 13

Performance evaluation of a hammer mill

14 **0 Hours**

EXPERIMENT 14

Performance evaluation of a steam distillation process

Total: 71 Hours

Reference(s)

1. R.L. Earle, Unit Operations in Food Processing, Butterworth-Heinemann Ltd; 2nd Revised edition, Pergamon Press, 1983.
2. C.J.Geankoplis, Transport Process and Unit Operations, 3rd edition, Prentice-Hall of India Private Limited, New Delhi, 1993.
3. J.M. Coulson and J.F. Richardson, Chemical Engineering, Volume I to V, The Pergamon Press, New York, 1999.

4. W.L. McCabe, J.C. Smith and P.Harriot, Unit Operations of Chemical Engineering, 7th edition, McGraw-Hill. Inc, Kosaido Printing Ltd. Tokyo, Japan, 2005

22HS007 ENVIRONMENTAL SCIENCE 2 0 0 0

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Examine the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation
3. Impact the existing environmental challenges related to pollution and its management
4. Select suitable strategies for sustainable management of components of environmental science
5. Correlate the impacts of population and human activities on environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

UNIT I **6 Hours**

NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids - Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity -

endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution : (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods - earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development : Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA)

Total: 30 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering , 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012. Environment. 8th edition. John Wiley & Sons
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press
5. A. K. De, Environmental Chemistry, 7th Edition , New age international publishers, New Delhi, 2014

22HS008 ADVANCED ENGLISH AND TECHNICAL EXPRESSION

0 0 2 1

Course Objectives

- To enable students to achieve proficiency in academic writing
- effectively use the language to persuade others
- appreciate the nuances of the language and engage an audience
- use advanced tools of language to improve communicative competence
- prepare for professional demands at the workplace
- give concrete expression to the plans and goals

Programme Outcomes (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Understand the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									2	3				
2									2	3				
3									2	3				
4									2	3				
5									2	3				

UNIT – 1 - CREATIVE EXPRESSION **15 Hours**

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: ‘Why should we hire you?’ Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

UNIT 2 - FORMAL EXPRESSION **15 Hours**

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning - SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace &L.Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N.K.Agrawal&F.T.Wood, Macmillan India Ltd., New Delhi

22FD501 BAKING AND CONFECTIONERY TECHNOLOGY

3 0 2 4

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and cakes
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the principles of baking and analyze the role of ingredients in baking
2. Compare the processing method for the production of biscuits and cookies
3. Apply the production process for different types of confectionery products
4. Illustrate and analyze the processing parameters of baking machineries
5. Assess the standards and quality control for bakery and confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2									2			2
2			2							2				2
3			2	2									2	
4	2				2						2			2
5		2	2										2	

UNIT I **9 Hours**

BAKING PRINCIPLES AND BREAD

Introduction to wheat- Structure, types, quality evaluation. Dough rheology. Baking principles, Bread- role of ingredients and its chemistry, additives, varieties of bread. Methods of bread preparation- advantages and disadvantages, bread spoilage and remedies. Cake- types of cakes, role of ingredients, cake mixing methods, Preparation, faults and remedies.

UNIT II **9 Hours**

BISCUIT AND COOKIES

Biscuits and cookies - role of ingredients. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Classification and Production of biscuits and cookies. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **9 Hours**

CONFECTIONERY PRODUCTS

Introduction - Role of ingredients and additives used in confectionery. Cocoa products and its uses in confectionery. Stages of Sugar cookery. Types of confectionery products and manufacturing process - chocolate, caramels, toffees, fondants, fudges and flour confectionery.

UNIT IV **9 Hours**

BAKERY EQUIPMENT

Equipment and machineries for a bakery unit - Light Equipment, Heavy/ Bulk handling Equipment - Dough mixers, Dividers, rounding, sheeting and laminating machines. Ovens and Slicers. Packaging equipment.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT

Packaging requirements and materials. FSSAI Standards and regulations for bakery and confectionery products. Quality control and Good Manufacturing Practices (GMP). Layout for Baking and Confectionery plant.

1 **3 Hours**

EXPERIMENT 1

Estimation of gluten content in wheat and refined flour

2 **3 Hours**

EXPERIMENT 2

Quality analysis of wheat and maida flour

3 **3 Hours**

EXPERIMENT 3

Determination of protein quality in wheat and maida flour

4 **3 Hours**

EXPERIMENT 4

Experiment on the preparation of Cookies

5 **3 Hours**

EXPERIMENT 5

Experiment on the preparation of Muffins

6 **3 Hours**

EXPERIMENT 6

Determination of Dough characteristics using farinographic and extensographic

7 **3 Hours**

EXPERIMENT 7

Experiment on preparation of Bun and bread rolls

8 **3 Hours**

EXPERIMENT 8

Preparation and analysis of baking and quality parameters in plain and fancy cakes

9 **3 Hours**

EXPERIMENT 9

Experiment on Preparation of candies

10 **3 Hours**

EXPERIMENT 10

Experiment on preparation of Fudge and Fondant

Total: 75 Hours

Text Book(s)

1. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
2. Iain Davidson, Biscuit, Cookie, and Cracker Production: Process, Production, and Packaging Equipment,Academic Press, Elsevier, 2018

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
3. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007

22FD502 FRUITS AND VEGETABLES TECHNOLOGY

3 0 2 4

Course Objectives

- Implement specific post harvest handling technique for storage and transport of fruits and vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the industrial scale processing and preservation methods to extend the shelf life of fruit and vegetable commodities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				2								1
2	2				2							-		2
3	2	1		2	-									1
4	2	-	2	1										1
5	2			2	2									2

UNIT I **9 Hours**

HARVESTING, HANDLING AND STORAGE OF FRUITS AND VEGETABLES

Fruits and vegetables: classification, nutritional profile - Harvesting of fruits and vegetables - maturity indices - post harvest physiology - handling - precooling and storage - Storage under ambient condition,
low temperature storage - chilling, frozen storage- chilling injury, freeze burn. Controlled atmosphere storage, Modified atmosphere storage - concepts and methods - gas composition - Changes during storage

UNIT II **9 Hours**

PRESERVATION OF FRUITS AND VEGETABLES BY VALUE ADDITION

Methods of fruit and vegetable preservation - Processing using sugar- Preparation of jam, jelly, marmalade, squash, RTS, crush, nectar, cordial, fruit bar, preserves, candies and carbonated, fruit beverages. Processing using salt - Brining - Preparation of pickles, chutney and sauces, ketchup. Machinery involved in processing of fruits and vegetables products

UNIT III **9 Hours**

PRESERVATION BY DRYING AND DEHYDRATION

Drying and dehydration - Types of driers - Solar, cabinet, fluidized bed drier, spouted bed drier, heat pump drier, vacuum drier and freeze drier - Applications. Preparation of product. Changes during drying
and dehydration. Problems related to storage of dried and dehydrated products.

UNIT IV **9 Hours**

MINIMAL PROCESSING AND FERMENTATION

Primary processing and pack house handling of fruits and vegetables; Peeling, slicing, cubing, cutting and other size reduction operations for fruits and vegetables, Minimal Processing of Fruits and Vegetables. Preservation by fermentation - wine, vinegar, cider and sauerkraut.

UNIT V **9 Hours**

CANNING AND BOTTLING

Canning - principles, types of cans - preparation of canned products - packing of canned products - spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations. General considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit.

5 **3 Hours**

EXPERIMENT 5

Preparation of pickles

6 **3 Hours**

EXPERIMENT 6

Minimal processing of fruits and vegetables

7 **3 Hours**

EXPERIMENT 7

Osmotic dehydration of fruits

8 **3 Hours**

EXPERIMENT 8

Osmotic dehydration of vegetables

9 **3 Hours**

EXPERIMENT 9

Dehydration of vegetables

10 **3 Hours**

EXPERIMENT 10

Sauerkraut fermentation

Total: 63 Hours

Reference(s)

1. 1. Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.
2. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
3. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.
4. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
5. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
6. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

22FD503 MEAT, POULTRY AND FISH TECHNOLOGY

3 0 0 3

Course Objectives

- Impart the processing technologies and equipment used for meat, fish and Poultry
- Understand the preservation and value addition of meat, egg and poultry products
- Assess the quality assurance, sanitation and packaging techniques for meat, fish and poultry products.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Analyze the scope, challenges, nutritive value and processing techniques of meat and its products
2. Assess the nutritive value, processing and quality parameters of Poultry, egg and its products
3. Apply the appropriate processing and preservation methods for fish and its products
4. Evaluate the quality and suitable packaging for meat, fish and poultry products
5. Apply the effective processing methods for waste/By-product utilization from meat and poultry industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2				3	1								
2	2				3	2								
3	3				3	2								
4	2				3	3								
5	2				3	3								

UNIT I **12 Hours**

MEAT PROCESSING

Meat processing industries- status and scope- Structure, composition and nutritive value of meat, Common and commercially important meats, pre -slaughter care-stunning methods-slaughtering method- evisceration and dressing of carcasses-refrigeration and transport, Meat tenderization and Meat quality evaluation. Rigor mortis - changes of meat, carcass chilling, ageing; storage of fresh meat. Processing and preservation of meat- aging, pickling, smoking. Dried and Cured meat. Canned meat, frozen meat, Cooked and Refrigerated meat, Sausages.

UNIT II **12 Hours**

POULTRY AND EGG PROCESSING

Composition and nutritive value of poultry meat, Types of poultry, production, classification & grading. Slaughtering, bleeding, scalding, defeathering, evisceration, chilling, packaging; storage. Egg structure, composition, nutritive value and functional properties of eggs and its preservation by different methods. Factor affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing. Egg quality assessment

UNIT III **9 Hours**

FISH AND FISH PROCESSING

Fish-composition and nutrition value, commercially important fish and shell fish, Processing and Preservation-chilling, freezing, canning, smoking, curing, salting and drying, fish meal and fish oils; ready-to-eat fish and other sea food products, spoilage factors, ship board operations, storage and transport.

UNIT IV **5 Hours**

PACKAGING AND QUALITY STANDARDS

Modified atmosphere packaging, packaging of retail cuts, Indian regulation and quality standards, Kosher and Halal certification, HACCP, Good Manufacturing Practices, meat plant sanitation and safety.

UNIT V **7 Hours**

EQUIPMENTS AND BY-PRODUCT UTILIZATION

Meat processing equipment - Meat grinder, Sausage stuffer, Hand crank meat tenderizer, meat mixer, meat mincer and meat slicer. Poultry processing equipment - Chicken feather plucking machine, cutter, Slaughter machine, Bone and meat cutter. Fish processing equipment - Fish slicing machine, Fish gutting machine, fish grader, fish de-scaling machine, Solid waste, Liquid waste, Chicken rendering unit-Dry rendering, wet rendering, Effluent Treatment Plant, By product utilization.

Total: 45 Hours

Reference(s)

1. A.M Pearson and T.A. Gillett, Processed Meats, CBS Publishers & Distributors, Third Edition, New Delhi, 1997.
2. P.C. Panda, Text Book on Egg and Poultry Technology, Vikas Publishing House Pvt. Ltd., New Delhi, 1998.
3. K.K. Balachandran, Post harvest Technology of fish and fish products, Daya publiching house, Delhi, 2001.
4. G.M. Hall, Fish processing Technology, Blackie Academic and Professional, London, 1997.
5. W.J. Stadelman and O. J. Cotterill, Egg science and Technology, AVI Publishing Co., Connecticut, 1995.
6. V.P. Singh and Neelam Sachan, Principles of meat technology, New India publishing agency, New Delhi, 2012

22FD504 DAIRY TECHNOLOGY 3 0 2 4

Course Objectives

- Impart knowledge on the principles of baking process
- Introduce baking techniques to produce bread, biscuits and cakes
- Familiarize with standards and regulations applied in food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the principles of baking and analyze the role of ingredients in baking
2. Compare the processing method for the production of biscuits and cookies
3. Apply the production process for different types of confectionery products
4. Illustrate and analyze the processing parameters of baking machineries
5. Assess the standards and quality control for bakery and confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		2								-	2			2
2		-	2							2				2
3			2	2									2	
4	2				2						2			2
5		2	2										2	

UNIT I **9 Hours**

BAKING PRINCIPLES AND BREAD

Introduction to wheat- Structure, types, quality evaluation. Dough rheology. Baking principles, Bread- role of ingredients and its chemistry, additives, varieties of bread. Methods of bread preparation-

advantages and disadvantages, bread spoilage and remedies. Cake- types of cakes, role of ingredients, cake mixing methods, Preparation, faults and remedies.

UNIT II **9 Hours**

BISCUIT AND COOKIES

Biscuits and cookies - role of ingredients. Types of biscuit dough - Developed/ Hard dough- semi-sweet, fermented and puff; Soft dough, short dough biscuits. Classification and Production of biscuits and cookies. Quality tests for biscuits and cookies. Faults and remedies.

UNIT III **9 Hours**

CONFECTIONERY PRODUCTS

Introduction - Role of ingredients and additives used in confectionery. Cocoa products and their uses in confectionery. Stages of Sugar cookery. Types of confectionery products and manufacturing process - chocolate, caramels, toffees, fondants, fudges and flour confectionery.

UNIT IV **9 Hours**

BAKERY EQUIPMENTS

Equipment and machineries for a bakery unit - Light Equipment, Heavy/ Bulk handling Equipment - Dough mixers, Dividers, rounding, sheeting and laminating machines. Ovens and Slicers. Packaging equipment.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL FOR BAKERY AND CONFECTIONERY PRODUCT

Packaging requirements and materials. FSSAI Standards and regulations for bakery and confectionery products. Quality control and Good Manufacturing Practices (GMP). Layout for Baking and Confectionery plant.

1 **3 Hours**

EXPERIMENT 1

Estimation of gluten content in wheat and refined flour

2 **3 Hours**

EXPERIMENT 2

Quality analysis of wheat and maida flour

3 **3 Hours**

EXPERIMENT 3

Determination of protein quality in wheat and maida flour

4 **5 Hours**

EXPERIMENT 4

Experiment on the preparation of Cookies

5 **3 Hours**

EXPERIMENT 5

Experiment on the preparation of Muffins

6 **3 Hours**

EXPERIMENT 6

Determination of Dough characteristics using farinographic and extensographic

7 **3 Hours**

EXPERIMENT 7
Experiment on preparation of Bun and bread rolls

8 **3 Hours**

EXPERIMENT 8
Preparation and analysis of baking and quality parameters in plain and fancy cakes

9 **0 Hours**

EXPERIMENT 9
Experiment on Preparation of candies

10 **0 Hours**

EXPERIMENT 10
Experiment on preparation of Fudge and Fondant

Total: 71 Hours

Reference(s)

1. Manley, Duncan., Technology of Biscuits, Crackers and Cookies, Woodhead Publishing Ltd., England, third edition, 2000.
2. Bernard, W. Minifie, Chocolate, cocoa and confectionery: CBS Publishers and Distributors, New Delhi, 1997.
3. Ashokkumar Y, Textbook of Bakery and Confectionery, Prentice Hall India Learning Private Limited; 2 edition (2012)
4. Paula Figoni, How baking works (Exploring the fundamentals of baking science), John Wiley & sons, 2007

22FD601 FOOD PROCESSING PLANT DESIGN AND LAYOUT

3 1 0 4

Course Objectives

- Impart basic knowledge in selecting a location as well as plant layout with respect to material handling, space utilization, future expansion etc.
- Understand the importance of availability of raw material and facilities for production of goods
- Integrate man, materials and machinery for optimum production

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Design layout for various types of food processing industries
2. Construct project profile analysis and prepare project report
3. Design water storage systems and prepare electrical layout
4. Apply different methods for production planning
5. Demonstrate the repair and maintenance of equipment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	1	2	2	1	2	1					
2	1	1	2	3	3	1		1	3	3	3			
3	3	3	2	2	3	3	1	1			3			
4	1	2	1	2	1	2	2	1		2	3			
5	1	3	2	1	2	2		1			1	1		

UNIT I **9 Hours**

PLANT LOCATION AND LAYOUTS

Introduction to food plant design - special features of food and agricultural process industry - plant location - location factors, site selection, location theory and models - layout - objectives, classical and
practical layout - preparation of process chart and machinery layout - product layout and process layout
- plant layout for size reduction machinery, evaporation plant, drying plant, heat exchanger plant, refrigeration and packaging plant.

UNIT II **9 Hours**

PROJECT PROFILE ANALYSIS

Project profile, key aspects to consider in preparing a project profile and DPR (Detailed Project Report),
Describing Project Operations, Categorizing Costs, Environmental Sustainability, completing and interpreting the profile, Project Profile Formats, Preparing model project report on fruit and vegetable processing unit.

UNIT III **9 Hours**

ELECTRICAL AND WATER SUPPLY

Estimation of services - peak and critical load - preparation of electrical layout - selection of fittings and accessories for electrical and water supply - provision of water supply - design of water storage system - selection of pipe, valves and safety devices - drainage - systems, pipeline, traps, safety devices
- illumination and ventilation - materials, mounting, operation and maintenance - layout for effluent treatment plant - safe disposal of effluent.

UNIT IV **9 Hours**

PRODUCTION PLANNING AND CONTROL

Production planning and control - continuous and intermittent production - scheduling - routing and dispatching - activity chart and Gantt chart - network planning methods - PERT and CPM - applications
- method study - work study - methods - man-machine chart - time study - standard time of a job - inventory control - economic ordering quantity - inventory models.

UNIT V **9 Hours**

REPAIR AND MAINTENANCE OF EQUIPMENT

Repair and maintenance of equipment - preventive maintenance and breakdown maintenance - replacement of equipment - alternative methods and analysis - method of annual equivalence, present worth method and internal rate of returns.

1 **3 Hours**

EXPERIMENT 1

Global migration testing for packaging

2 **3 Hours**

EXPERIMENT 2

Measuring GSM of various paper and flexible film based packaging materials.

3 **3 Hours**

EXPERIMENT 3

Measuring water absorption by different paper and paper boards using Cobb tester

4 **3 Hours**

EXPERIMENT 4

Measuring tensile strength of flexible films using UTM

5 **3 Hours**

EXPERIMENT 5

Measuring compressive strength of carton boxes using UTM

6 **3 Hours**

EXPERIMENT 6

Measuring drop strength of packaged food material using drop tester

7 **3 Hours**

EXPERIMENT 7

Measuring compressive strength of oil packaged in flexible pouches using Pouch burst tester

8 **3 Hours**

EXPERIMENT 8

Measuring bursting strength of different paper board based packaging materials

9 **3 Hours**

EXPERIMENT 9

Experiment on opening and closing torques of foods packed in bottles/Jars using torque tester

10 **3 Hours**

EXPERIMENT 10

Experiment on form fill seal machine - vertical type

Total: 90 Hours

Reference(s)

1. O.P.Kanna, Industrial Engineering and Management, DhanpatRai Publication (P) Ltd., New Delhi, 2003.
2. S.P. Arora and S.P. Bindra, A Text Book of Building Construction, 5th edition, Dhanpat Rai Publications (p) Ltd., New Delhi, 2014.
3. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A., 2003.
4. Antonio Lopez-Gomez and Gustavo V. Barbosa-Canovas, Food Plant Design, CRC, London, 2005.
5. C.S.Rao, Environmental Pollution Control Engineering, New age International (P) Ltd., New Delhi, 1999.
6. G.K. Agarwal, Plant layout and materials handling, Jain brothers, New Delhi, 2008.

22FD602 FOOD EQUIPMENT DESIGN 3 1 0 4

Course Objectives

- Impart knowledge on basic principles of designing equipment for food processing
- Become familiar with design and manufacture of storage tanks, pulpers, heat exchangers, driers etc
- Provide an idea about devising cold storage units, freezers etc

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyze the process parameters of equipment and design pressure vessels, storage tanks and pulper
2. Select the suitable products and materials for designing heat exchangers and evaporator
3. Design and analyze the performance of dryers and extruders.
4. Estimate the cooling load of cold storage and design a cold storage for fruits and vegetables
5. Analyze and determine the parameter for designing size reduction and conveying equipment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3		2	1		1			1				1	
2	3		2								1		2	
3	3		2	1							2			1
4	2		2			1	1	-			2		2	
5	2		2			2							2	

UNIT I **9 Hours**

DESIGN OF PRESSURE VESSELS, STORAGE TANKS AND PULPER

Introduction to design - principles and selection of food processing equipment - design of pressure vessels - design aspects of storage tanks, design of sterilizers and process vats - design of pulper - design considerations - materials of construction - installation and operation.

UNIT II **9 Hours**

DESIGN OF HEAT EXCHANGERS AND EVAPORATORS

Design of heat exchangers - plate heat exchanger, shell and tube heat exchangers - materials of construction - installation and operation - design of single effect evaporators - applications -multiple effect evaporators- entrainment separators-installation and maintenance

UNIT III **9 Hours**

DESIGN OF DRYERS AND EXTRUDERS

Design of dryers - cabinet dryer, fluidized bed dryer, heat pump dryer, foam mat dryer - freeze dryer - Spray dryer - design considerations, installation, operation and maintenance - design considerations of food extruders - single and twin screw extruders - installation, operation and maintenance of food extruders

UNIT IV **9 Hours**

DESIGN OF COLD STORAGE AND FREEZERS

Design of cold storage - estimation of cooling load - construction, operation and maintenance of cold storage -design consideration for controlled atmospheric storage and modified atmospheric storage of perishables - design of freezers - types of freezers - design considerations - construction and operation-design of frozen storage

UNIT V **9 Hours**

DESIGN OF SIZE REDUCTION AND CONVEYING EQUIPMENTS

Design consideration of size reduction equipment- installation and maintenance-design consideration of material conveying equipment- belt conveyor- screw conveyor - bucket elevator- pneumatic conveyor

Total: 60 Hours

Reference(s)

1. P.S. Phirke, Processing and conveying equipment design, Jain Brothers, New Delhi, 2004
2. M.V. Joshi and V.V. Mahajani, Process Equipment Design (3rd edition), New India Publishing Agency, New Delhi, 2004
3. Jasim Ahmed and Mohammad Shafiur Rahman (Editors), Handbook of Food Process Design, John Wiley and Sons, Ltd., U.K., 2012
4. Kennath. J. Valentas and R.Paul Singh (Editors), Handbook of Food Engineering Practice, CRC Press, London, 1997
5. Zacharias B. Maroulis and George D. Saravacos, Food Process Design, Marcel Dekker, Inc. U.S.A, 2003

22FD603 FOOD INSTRUMENTATION AND ANALYSIS

3 0 2 4

Course Objectives

- Expose the principles of chemical and instrumental methods of food analysis
- Expose the methods of chemical and instrumental methods of food analysis
- Expose the techniques of chemical and instrumental methods of food analysis

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the principles behind analytical techniques in food analysis.
2. Know the methods of selecting appropriate techniques in the analysis of food products.
3. Appreciate the role of food analysis in food standards and regulations for the manufacture and the sale of food products
4. Implement food quality control in food industries
5. Familiarize with the current state of knowledge in food analysis

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	-	1	1										2	
2	2	-						2				2	2	
3		2			1			2				2	2	
4			2		2			1				2	2	
5		2										2		2

UNIT I **9 Hours**

INTRODUCTION

Introduction, food regulations and standards; sampling methods, and sample preparation for analysis; statistical evaluation of analytical data. General methods of food analysis- Moisture determination by different methods; ash analysis-different methods; titrable acidity in foods; determination of crude

fiber
and dietary fibre.

UNIT II **9 Hours**

LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS

Analysis of oils and fats for physical and chemical parameters and quality standards, protein analysis by different techniques; analysis of carbohydrates by different techniques.

UNIT III **9 Hours**

SPECTROSCOPIC TECHNIQUES

Basic principles; application of UV-Visible spectrophotometer in the analysis of food additives; IR Spectroscopy in online determination of components of food- FT-IR tintometer in color intensity determination; application of Atomic Absorption Spectrophotometer, Atomic emission spectrophotometer and applications.

UNIT IV **9 Hours**

CHROMATOGRAPHIC TECHNIQUES

Basic principles; application of paper chromatography and TLC in food analysis; detection of adulterants in foods; Column chromatography for purification analysis- Ion exchange and affinity chromatography; HPLC and GC in food analysis; Significance of MS detectors in HPLC and GC; FAME analysis in oils and fats

UNIT V **9 Hours**

ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY

Basic principles; application of the electrophoresis in food analysis; Brixs value of fruit juices; total soluble solids in fruit products; Refractive indices of oils and fats; specific rotations of sugars; Estimation of simple sugars and disaccharides by polarimeter.

1 **3 Hours**

EXPERIMENT 1

Estimation of pH and Titratable acidity

2 **3 Hours**

EXPERIMENT 2

Determination of moisture content and water activity

3 **3 Hours**

EXPERIMENT 3

Estimation of total sugars by titrimetric method

4 **3 Hours**

EXPERIMENT 4

Estimation of starch by (a) titrimetric method (b) calorimetric method.

5 **3 Hours**

EXPERIMENT 5

Estimation of total polyphenols

6 **3 Hours**

EXPERIMENT 6

Determination of Free Fatty Acids

7 **3 Hours**

EXPERIMENT 7
Determination of Free Fatty Acids

9 **3 Hours**

EXPERIMENT 9
Estimation of crude fibre

10 **3 Hours**

EXPERIMENT 10
Determination of antioxidant activity by DPPH Method

Total: 72 Hours

Reference(s)

1. Pomeranz, Yeshajahu. Food Analysis: Theory and Practice 3rd Edition. Aspen Publishers / Springer, 2000
2. Nielsen, S. Suzanne. Food Analysis 3rd Edition. Springer, 2003
3. Otles, Semih. Methods of Analysis of Food Components and Additives, CRC Press, 2005

22FD701 FOOD LAWS AND SAFETY STANDARDS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of foodborne illness - viz. physical, chemical and biological.- and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Analyse the sources of food spoilage and food toxicants.
2. Identify the food quality evaluation methods.
3. Execute the food inspection procedures to evaluate the food quality
4. Select the National and International Food laws and regulations.
5. Evaluate the quality control measures in food processing industry and marketing center.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1		1				3		2				2	1	2
2		3				3	1		2			1	1	2

3		3						1	1	1		1	2	1
4	3				2							1		
5	2	2	2			1			1			3		

UNIT I **9 Hours**

FOOD SAFETY

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and microorganisms- microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination, Limits for pesticide and metal contamination of food. Adulteration, Food additives- types- usage, permissible limits, concept of safe food.

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality AttributesClassification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials-Fruits, vegetables, cereals, legumes, dairy products, meat, poultry, egg and processed food. Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation and Evaluation cards, Different methods of Quantitative descriptive analysis.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control, Quality control specifications, training of food technologists for quality control, implementation of standards and specifications.

Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV **12 Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labeling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe(GRAS), European Council (EU) , Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHER

UNIT V **6 Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Total: 45 Hours

Reference(s)

1. Manoranjan Kalia, Food analysis and Quality control, Kalyani Publishers, Ludhiana, 2002.
2. Mehta, Rajesh and J. George, Food Safety Regulation Concerns and Trade: The Developing Country Perspective, Macmillan, 2005.
3. P.A. Luning, F. Devlieghere and R. Verhe, Safety in the agri - food chain, Wageningen Academic Publishers, Netherland, 2006.

4. Leo and M.L. Nollet, Handbook of food analysis - Methods and Instruments in applied food analysis, Marcel Dekker Inc., 2004.
5. J. Andres Vasconcellos, Quality Assurance for the Food Industry: A Practical Approach, 1st Edition, 2003.
6. V Ravishankar Rai, Jamuna A Bai,Food Safety and Protection 1st Edition,CRC Press,2017

22FD702 FOOD WASTE MANAGEMENT 3 0 2 4

Course Objectives

- Understand the importance of treating waste product from food industry
- Learn different solid and liquid management techniques
- Impart knowledge on different treatment methods and recycling of waste product from food industry

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Analyse the impacts of food wastage and its causes in environment
2. Assess and analyze the different food industry wastes leads to environmental pollution
3. Apply the physical, chemical and biological principles for liquid waste treatment
4. Analyze the solid waste management techniques
5. Evaluate the by-product/waste utilization from different food processing industries

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						3	3	3				1		
2	1				2	3	3	1						
3	2		1		1	3	3	1		1	3			
4	2		1		2	3	3	2		2	3			
5	2		1		1	2					2			

UNIT I **6 Hours**
INTRODUCTION TO WASTE MANAGEMENT

Definition-Food wastage- food loss- global scenario- Sources of waste and pollutants, Classification and characterization of wastes - causes and prevention of food waste- impact of food losses and waste-food waste hierarchy-need for minimization of food waste

UNIT II **9 Hours**

FOOD INDUSTRY WASTES AND ENVIRONMENTAL POLLUTION

Food Industries- Environmental Pollution due to Food Industry wastes - characteristics and impact on soil, water, air pollution - Processes for waste utilization from fruit and vegetable industries, meat, fish, dairy, oil processing industries.

UNIT III **12 Hours**

LIQUID WASTE MANAGEMENT IN FOOD INDUSTRIES

Principles of Physical treatment - Screening, Sedimentation, Filtration, back washing, membrane separation. Principles of Chemical treatment- COD, BOD, VLSS, MLSS and ETP. Coagulation, flocculation, Precipitation, flotation, Disinfection and fluoridation. Principles of biological treatment, aerobic process, activated sludge process, trickling filters, anaerobic digestion, UASB reactor.

UNIT IV **6 Hours**

SOLID WASTE MANAGEMENT IN FOOD INDUSTRIES

Solid waste management techniques, Principles and practices, 3R concept, resource recovery. Composting methods of composting, vermicomposting- Incineration, pyrolysis Briquetting - value addition, Pelletizing, SCP, enzymes, pectin.

UNIT V **12 Hours**

BY PRODUCT/WASTE UTILIZATION

Utilization of oil cake and defatted oil cake as cattle feed and industrial uses. Utilization of sugarcane tops, bagasse, molasses and press mud - animal feed from sugarcane tops and bagasse - Utilization of agro-industries - Utilization of furfural and activated carbon-Environmental Laws and Acts-Regulatory issues with food industry waste

Total: 45 Hours

Reference(s)

1. Ioannis S. Arvanitoyannis, Waste Management for the Food Industries, Academic Press, 2008.
2. Wang, L. K., Lo, H. H., Hung, Y. T., & Yapijakis, C. Waste treatment in the food processing industry, CRC Press,2005
3. Lawrence K.Wang, Yung-Tse Hung, Howard H.Lo and Constantine Yapijakis, Waste Treatment in the Food Processing Industry, CRC press, Taylor and Francis Group, 2006.
4. Sylvan H Wittwer, Food, Climate and Carbon Dioxide: The Global Environment and World Food Production, CRC Press, 1995.
5. S.N. Jogdhand, Environmental Biotechnology: Industrial Pollution Management, (III ed), Himalaya Publishing House, New Delhi, 2010.

22FD708 PROJECT WORK I 0 0 6 3

Course Objectives

- To develop knowledge to formulate a real world problem and project"s goals.
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 0 Hours

22FD801 PROJECT WORK II **0 0 18 9**

Course Objectives

- Develop knowledge to formulate a real world problem and project"s goals.
- Identify the various tasks of the project to determine standard procedures.
- Identify and learn new tools, algorithms and techniques.
- Understand the various procedures for validation of the product and analysis the cost effectiveness.
- Understand the guideline to Prepare report for oral demonstrations

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

Course Outcomes (COs)

1. Formulate a real world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness
5. Prepare report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		1								
2	2	2	1	2		1								
3	3	2	2	2		2								
4	3	3	2	3		2								
5	3	3	2	2		2								

Total: 0 Hours

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Increase ability to comprehend complex content
- Enhance confidence in expressing with clarity and elegance
- Enthusiastic and reflective use of the language through sufficient and focused practice
- Articulate fluently and confidently in challenging situations

Programme Outcome (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Engage with the English language in functional contexts
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3		3		
2									3	3		3		
3									3	3		3		
4									3	3		3		
5									3	3		3		

UNIT I **15 Hours**

SELF-EXPRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and weaknesses-Abstract nouns -Adjectives-Active Listening skills-Note making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional ethics-Reported Speech-Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses- Hypothetical questions and answers-Sentence Structure-Simple Present Tense-Perfect tense

UNIT II **15 Hours**

CREATIVE EXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept explanation-Reported speech-Voice Sentence equivalence-Proofreading

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and Found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and Articles-Spelling-Reading: Analyzing and interpreting notices and Circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking FoundationBooks, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010.
4. Reynolds, John. Cambridge First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

Programme Outcome (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

VOWELS AND CONSONANTS

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises

UNIT III **9 Hours**

PRONOUNS AND TENSES

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Classified Vocabulary: Parts of body -Relatives Spices Eatables -Fruit & Vegetables -Clothes -Directions -Seasons Professions.

UNIT V **9 Hours**

CONVERSATIONS

Speaking -Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

22HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

Programme Outcome (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. Use basic phonemes and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
5. Understand basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns -articles-Speaking about oneself-Listening to CD supplied with books-paying special attention to pronunciation

UNIT III **9 Hours**

TECHNICAL DEUTSCHE

Regular &Irregular verbs -Personal pronouns-family-Introduction to types of sentences

UNIT IV **9 Hours**

INTERROGATION

Question words -Types of Questions -Nominative case-Verb Conjugation -country -nationalities

UNIT V **9 Hours**

IMPLEMENTATION

Verbs to be & to have -conjugation -Hobbies -Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 JAPANESE **1 0 2 2**

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

Programme Outcome (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3				

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions -Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time -Introduction of verbs -Listening to specific information

UNIT III **9 Hours**

ADJECTIVES

Word Sentence -Introduction to Adjectives -Technical Japanese Vocabulary -Pair Activity Day to day situational conversation, Listening to Japanese Alphabet Pronunciation -Simple Conversation

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences -Past tense of ii adjective sentences -houga adjective desu -Technical Japanese Vocabulary -Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary -Listening to different Counters, simple conversations with verbs and adjectives

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

Programme Outcome (POs)

i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1									3	3				
2									3	3				
3									3	3				
4									3	3				
5									3	3		-		

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu
Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie -

Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait - Communication Propose a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite - Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant - Lexique Les services et les commerces, les aliments, les ustensiles, l argent

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

22FD001 FOOD PACKAGING TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Apply the functions of food packaging for socio-economic needs
2. Analyze the importance of Chemical alteration in Natural macromolecular compounds.
3. Find the importance of processing Non-renewable materials in traditional packaging.
4. Apply the new innovation in developing advanced packaging material
5. Analyze the response to the changes in processing foods by modern packaging techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2	1	2	1	1				1			
2	1	2	2	1	2	1								
3	1	1	1	1	3	1	3				1			
4	2	2	2		2	1	2							
5	1	2	1								1			

UNIT I **9 Hours**

INTRODUCTION TO FOOD PACKAGING

Introduction,Definitions, Functions of packaging - Containment, Protection, Convenience, Communication. Packaging Environments - Physical Environment, Ambient Environment, Human Environment. Functions/ Environmental Grid, Socio-Economic Needs. Deterioration reactions in foods - Deteriorative reactions & Factors. Shelf life of Food.

UNIT II **9 Hours**

PLASTIC POLYMERS

Structure and Related Properties of Plastic Polymers-Factors influencing polymers structures and related properties(Molecular structure, Molecular weight , Density , Crystallinity, Physical Transitions in Polymers,Chemical structures , and Additives in plastics).Optical , Mechanical, and Barrier properties of Thermoplastic polymers. Processing and Converting of Thermoplastic Polymers.

UNIT III **9 Hours**

EDIBLE , BIOBASED

Edible Packaging materials- Polysaccharides, Lipids, Proteins, Composite materials, Film additives,Bionanocomposites. Biobased & Biodegradable Packaging materials- Classification, Degradability,Degradability of Biobased polymers,OBD Polymers, Category 1,2,3,4,Properties of Biobased packaging materilas (Barrier & Mechanical),Current Limitations, Methods to improve Functionality, Bionanocomposites,Applications. Environmental Aspects & Future trends.

UNIT IV **9 Hours**

ASEPTIC PACKAGING

Aseptic packaging- Introduction (History & Principles of Sterilization),Steerilization of packaging material food contact surface (Irradiation,Heat,Chemiccal Treatments,Verification of Sterilization process),Aseptic packaging systems(Carton systems,Bottle systems,Sachey & Pouch sytems , Cup systems) Integrity Testing of Aseptic Packages.Packaging of Microwavable Foods- Introduction,Basic principles,Effect of food Product, Packaging (Transparent, Absorbent, Shielding & Field modification, Doneness Indicators,Testing methods & Safety)

UNIT V **9 Hours**

ACTIVE AND INTELLIGENT PACKAGING

Active and Intelligent Packaging- Definitions,Active packaging systems (Sachets and Pads, Active packaging materials, Self- Heating and Self- CoOling Packages, Changing gas permeability, Widges), Intelligent Packaging (Indicating Product Quality, Convenience,Theft,counterfeiting & Tampering,safety& regulations). Modified atmospheric packaging- Introduction, Principles, Gas used in MAP, Methods of creating MA conditions, Equipment involved, Applications, Microbiology of MAP, Safety, Refrigerated & Pasteurized Foods with Extended durability and Sous vide.

Total: 45 Hours

Reference(s)

1. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.
2. Gordon L. Robertson, Food Packaging: Principles and Practice, Third Edition (Food Science and Technology), Taylor & Francis, CRC Press, 2013
3. NIIR Board, Food Packaging Technology Handbook (2nd Revised Edition), NIIR Project Consultancy Services, 2012.

4. Richard Coles and Mark J. Kirwan, Food and Beverage Packaging Technology, Second Edition, Wiley & Blackwell, 2011.
5. K.L. Yam and D.S. Lee, Emerging Food Packaging Technologies, Principles and Practice, A volume in Woodhead Publishing series in Food Science, Technology and Nutrition, 2012.
6. Dong Sun Lee, Kit L. Yam and Luciano Piergiovanni, Food Packaging Science and Technology, CRC Press, 2

22FD002 FOOD PACKAGING DESIGN AND DEVELOPMENT

3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.

Course Outcomes (COs)

1. Apply the functions of food packaging for food processing industries
2. Analyse the importance of 2D & 3D sketching of Packaging Design
3. Find the importance of fabrication techniques for food packaging materials
4. Analyse the importance of printing techniques in food packaging
5. Apply the new innovation in developing advanced packaging material

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2

1	1	1	1		1	1	2							
2	2	1	1	1	2	1								
3	2	2	2	1	2	1	3				1			
4	1	2	2	1	2	1	2							
5	1	2	1								1			

UNIT I **9 Hours**

INTRODUCTION

History-Past Innovations-Outline of traditional and modern food packaging system, Residual migration of food packaging system, Dyes- synthetic and non-synthetic.Types of Packaging materials used in food processing industry.

UNIT II **9 Hours**

PACKAGING DESIGN AND

Principles-2D and 3D sketching , Preparation of key line diagram- Primary, Secondary and Tertiary packaging materials , Basics of Computer Aided Engineering and Design.Food packaging design and simulation, CAD and CAM application in Food INdustry. Food packaging design as per FSSAI guidelines.

UNIT III **9 Hours**

PACKAGING MOULDING TECHNIQUES

Introduction-Paper & Paper Board, Cartons, Glass,Metals and plastic materials for food packaging system. Types of Moulding Techniques- Paper Pulping, Fabrication of corrugated Fiber board.Glass forming techniques, Thermostat & Thermopiles packaging materials. Processing of metal tin/can.

UNIT IV **9 Hours**

PRINTING TECHNIQUES IN PACKAGING MATERIALS

Introduction-Types of printing techniques involved in food packaging materials- Offset,Screen, Flexographic and Digital Printing

UNIT V **9 Hours**

NOVEL FOOD PACKAGING DESIGN

Introduction- Emerging packaging techniques, Design and principles of smart packaging system Design,Recent Innovation- Intelligent packaging, Application of Active packaging system-Anti-microbial,Anti-Oxidant, Anti- Freezeand Fortification in packed food via active materials . Development of packaging materials using novel biomaterials.

Total: 45 Hours

Reference(s)

1. W.Soroka, Fundamentals of packaging Technology, IoPP
2. Plastics: Materials and processing, pearson-prentice Hall
3. Paper and paperboard Packaging Technology, Mark J. Kirwan, Blackwell Publishing
4. Harald Johnson, Understanding Digital Printing, Thomson Publisher, Boston
5. Barnard & peacock, Hand book of print and production
6. Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishers, 2003.

22FD003 DIVERSE MATERIALS IN FOOD PACKAGING **3 0 0 3**

Course Objectives

- Understand the properties and characteristics of glass, wood, metal, and cardboard as packaging materials.
- Analyze the advantages and disadvantages of each material for different packaging applications.
- Evaluate the sustainability issues related to packaging, including recyclability, biodegradability, and environmental impact.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Create an awareness of the historical and strategic dimensions of food packaging, understanding its protective function, logistic implications, and impact on shelf life in food marketing systems.
2. Evaluate the environmental impact of paper and paperboard packaging solutions by analysing and designing based on considerations such as fiber sources, manufacturing processes, and functional properties.
3. Understand the diverse facets of plastics in food packaging, encompassing manufacturing, and types, printing, sealing, and addressing environmental concerns.

4. Analyze market trends, container designs, raw materials, manufacturing processes, and corrosion challenges in metal packaging, gaining a deep understanding of its role in the food industry.
5. Apply knowledge in glass container packaging, recognizing glass as a marketing tool, by understanding its composition, manufacturing, closure techniques, thermal processing, and environmental considerations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1	2	1	2	1					-	-	1
2	1	2	2	2	1	3	1						-	-
3	1	1	2	1	3	1	3				-			
4	2	1	2			3	1						-	
5	1	1	2	1	1	1	3	1			-		1	

UNIT I **8 Hours**

FUNDAMENTALS OF FOOD

Introduction, Packaging developments-an historic perspective, Food supply and the protective role of packaging, basic functions of packaging, packaging strategy, packaging design and development, food bio deterioration and methods of preservation, packaged product quality and shelf life, Logistic packaging for food marketing systems.

UNIT II **8 Hours**

PAPER AND PAPERBOARD PACKAGING

Introduction, Paper and Paperboard- fibre source and fibre separation, Paper and paperboard manufacture-methods and process involved. Packaging papers and paperboards, properties of paper and paperboard, Additional funcional properties of paper and paperboard, Design for paper and paperboard packaging, package types, systems, environmental profile.

UNIT III **10 Hours**

PLASTICS IN FOOD PACKAGING

Introduction, Manufacture of plastics packaging, types of plastic used in packaging, coating of plastic films-types and properties, secondary conversion techniques, printing, printing and labelling of rigid plastic containers, food contact and barrier properties, sealabilty and closure, cold seal, platic closures for bottles, jar and tubs, adhesive systems used with plastics, retort pouch, environmental and waste managment issue, plastic manufacuturing and life cycle assessment (CLA), plastic waste management.

UNIT IV **9 Hours**

METAL IN FOOD PACKAGING

Overview of market for metal cans, container performance requirements, container designs, raw materials for can making-steel, aluminium, recycling of packaging metal, can-making processes, end making processes, coatings, film laminates and inks, processing of food anf drinks in metal pacakages, shelf life of canned foods, internal corrosion, stress corrosion cracking, environmental stress cracking corrosion fo aluminium alloy beverage can ends, sulphur staining, external corrosion.

UNIT V **10 Hours**

PACKAGING OF FOOD IN GLASS CONTAINERS

Definition of glass, brief history, glass packaging, glass containers market sectors for foods and drinks, glass composition, attributes of food packaged in glass containers, glass and glass container manufacture, closure section, thermal processing of glass packaged foods, plastic sleeving and decorating possibilities, strength in theory and practice, glass pack design and specification, packaging-due diligence in the use of glass containers, environmental profile, glass as a marketing tool.

Total: 45 Hours

Reference(s)

1. Food packaging technology by Richar coles, Derek MsDowelll and Mark J. Kirwan. Blackwell publishing, CRC press, 2003.
2. Food Packaging by Takashi Kadoya, Kanagawa University, Hiratsuka, Japan. Academic press,1990
3. Glass Packaging Technology" by Walter Sperling and Werner Holleis, Wiley-VCH, 2012.
4. Corrugated Packaging: The Essential Guide" by Neil McGuire, DEStech Publications, Inc., 2013.
5. Metal Packaging: Materials, Markets and Applications" by D.R. Gabe, Smithers Rapra Technology, 2010.
6. Cardboard in Architecture: Volume 7 of the Research in Architectural Engineering Series" edited by Reza Mokhtarian and Ali Araghi, CRC Press, 2018.

22FD004 EMERGING TRENDS AND INNOVATIONS IN PACKAGING TECHNOLOGY

3 0 0 3

Course Objectives

- Analyze and critically evaluate current trends and innovations in food packaging technology, including emerging materials, design concepts, and sustainability practices.
- Apply theoretical knowledge to assess the impact of technological advancements on food packaging, considering factors such as shelf life extension, preservation methods, and consumer preferences.
- Explore and synthesize information on cutting-edge developments in food packaging, fostering the ability to adapt and implement innovative technologies to address challenges in the ever-evolving food industry.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Understand the fundamentals of quality preservation in food through new technologies in packaging
2. Analyze active packaging technologies and evaluate their applications in food packaging.
3. Evaluate packaging properties for various fresh foods and comprehend their significance.
4. Create a deep understanding of edible and biodegradable coatings.
5. Apply knowledge of new packaging technologies and anticipating future trends in the dynamic field of food packaging.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1	1	-	1	1	2					-	-	-
2	2	1	1	2	1	-	-						-	-
3	2	2	2	1	2	1	3				-			

4	1	2	2			1	2						-	
5	1	2	1	-	-	-	-	-			-			-

UNIT I **8 Hours**

FUNDAMENTALS OF QUALITY PRESERVATION OF FOOD

New technologies in food packaging: overview, Mass transfer of gas and solute through packaging materials, quality of packaged foods, surface chemistry of food, packaging and biopolymer materials.

UNIT II **8 Hours**

ACTIVE PACKAGING

Introduction to active packaging technologies, antimicrobial packaging systems, packaging containing natural antimicrobial or antioxidative agents, oxygen-scavenging packaging, intelligent packaging

UNIT III **10 Hours**

MODIFIED ATMOSPHERIC PACKAGING

Introduction of Modified Atmospheric Packaging (MAP), internal modified atmospheres of coated fresh fruits and vegetables: relative humidity effects, MAP of ready to eat foods, preservative packaging for fresh meats, poultry and fin fish. Centralized packaging systems for meats.

UNIT IV **10 Hours**

EDIBLE AND BIODEGRADABLE COATINGS AND FILMS

Introduction to edible films and coatings, agro-polymers for edible and biodegradable films, edible films and coatings from plant origin proteins; animal origin proteins; starches; non-starch polysaccharides, lipid-based edible films and coatings, emulsion and bi-layer edible films, plasticizers in edible films and coatings, sensory quality of foods associated with edible films and coating systmes and shelf-life extension.

UNIT V **9 Hours**

COMMERICAL ASPECTS OF NEW PACKAGING TECHNOLOGIES

Commercial uses of active food packaging and MAP systems, US Food and Drug Administration regulations - The food additive petition process, Food contact sustance notifications, special considerations for antimicrobial food additives, packaging from non-thermal food processing, Future trends.

Total: 45 Hours

Reference(s)

1. Innovations in Food Packaging by Jung H. Han. Elsevier academic press, Food science and Technology, International series, 2005.
2. Food Packaging by Takashi Kadoya, Kanagawa University, Hiratsuka, Japan. Academic press,1990
3. Food packaging technology by Richar coles, Derek MsDowelll and Mark J. Kirwan. Blackwell publishing, CRC press, 2003.
4. Corrugated Packaging: The Essential Guide" by Neil McGuire, DEStech Publications, Inc., 2013.
5. Metal Packaging: Materials, Markets and Applications" by D.R. Gabe, Smithers Rapra Technology, 2010.
6. Food Packaging: Principles and Practice" by Gordon L. Robertson, CRC Press, 2012.

22FD007 RADIATION PRESERVATION AND PROCESSING OF FOOD PRODUCTS

3 0 0 3

Course Objectives

- Identify the importance of non-thermal methods like irradiation as an alternative to the conventional methods of processing.
- Understand the effect of radiation as a processing and preservation method.
- Learn the importance and safety issues of the irradiated foods.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Explain and apply the concept of Radiation chemistry on food preservation.
2. Analyze the effect of dosage of radiation on plant and animal foods.
3. Exemplify and analyze the effect of microwave in food processing.
4. Analyze the effect of Infra-red radiation in food processing.
5. Justify and assess the effect of radio frequency on foods.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	1	1		2							1	1
2	2	1	2	1		2								2
3	2	3	1	2		3								
4	3	2	2	1		2							3	3
5	3	2	3	2		2							2	2

UNIT I **9 Hours**

BASICS OF RADIATION CHEMISTRY

Electromagnetic energy, ionizing radiation, Concept of radiation, dielectric properties, ionization and excitation, Radiation chemistry basics - primary chemical effects and secondary effects on food, G value, irradiation parameters, instruments for measuring radiation, effect of food irradiation and potentialities for radiation processing of foods.

UNIT II **9 Hours**

RADIATION CHEMISTRY OF FOOD COMPONENTS

Basics-carbohydrates, proteins, lipids, vitamins etc. Radiation effect on contaminating microorganisms like bacteria, viruses, yeasts and molds - Dosages of radiation for various plant foods and animal foods-meat and poultry, fruits, vegetables, spices, dairy products; Radiation equipment, salient features; Packaging of irradiated foods and safety issues.

UNIT III **9 Hours**

MICROWAVES IN FOOD PROCESSING

Microwave heating, nature of energy, batch and continuous ovens, microwave generators, wave guides, brief description of oven construction, application of microwave radiation and safety measures.

UNIT IV **9 Hours**

INFRA RED RADIATION

Absorption and scattering characteristics of various food materials, Polarization characteristics of IR radiation, Propagation of IR radiation in food stuffs. IR generators, applications, Relative merits and demerits.

UNIT V **9 Hours**

RADIO FREQUENCY HEATING PRINCIPLES

RF heating equipment, Advantages of Radio frequency heating of foods - Ultra violet radiation and its effect on microorganisms in foods - UV treatment application and equipment.

Total: 45 Hours

Reference(s)

1. Welter M. Urbain: Food Irradiation Academic Press, New York, 1986
2. Ohlsson and Bengtson, Microwave Processing Technologies Woodhead Publishing, Cambridge, UK, 2002.
3. Gould G.W., New Methods of Food Preservation, Aspen Publishers Inc., Maryland, 1999.
4. S.G.Llyasor and V.V. Krasnikov, Physical Principles of Infra Red Irradiation of Food Stuffs: Hemisphere Publishing Corporation, London, 1991.
5. Philip Richardson, Thermal Technologies for Food Processing, Wood head Publishing Limited, CRC Press, 2001.
6. Robert V. Decareau, Microwave Foods, New Product Development Food & Nutrition Press Inc., USA, 1992.

22FD008 NON- THERMAL PROCESSING TECHNIQUES

3 0 0 3

Course Objectives

- Understand and apply the different non-thermal techniques in processing of foods.
- Familiarize about the equipment used for the processing of foods in non-thermal techniques
- Compare the application of alternate non-thermal processing techniques on foods

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals and principles of High-pressure processing on foods.
2. Analyze the importance of Pulsed electric field processing of solids and liquid foods.
3. Analyze the methodology and equipments in Ultrasound processing methods.
4. Apply non-thermal technologies for inactivation of microorganisms.
5. Analyze non-thermal techniques by electromagnetic energy for food processing and preservation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2				3							1	1
2	1		2	2		3								
3	1	3				3							2	2
4	2	1				3							1	1
5	2		1			3							2	2

UNIT I **9 Hours**

HIGH PRESSURE PROCESSING

Principles - Mechanism and applications of high-pressure processing to food systems - High pressure processing of salads, meats and seafoods, fruits and fruit products -Effect of high pressure on microorganisms, enzymes, textural and nutritional quality of foods - Other applications of high pressure processing - High Pressure Freezing: principles and equipment, types of high pressure freezing process, microbiological and enzymatic inactivation after high pressure freezing.

UNIT II **9 Hours**

PULSED ELECTRIC FIELDS PROCESSING

Principles - Mechanism - PEF treatment systems - Main processing parameters PEF technology -Equipment - Applications - Mechanisms of microbial and enzyme inactivation. PEF processing of solid foods, liquid foods and beverages. Food safety aspects of pulsed electric fields.

UNIT III **9 Hours**

ULTRASOUND PROCESSING

Principle of ultrasound - Fundamentals - Ultrasound as a processing and food preservation tool - Effect of ultrasound on properties of foods - Applications of ultrasound in microbial inactivation, assisted drying, extraction, osmotic dehydration, detection of foreign bodies, filtration and freezing - challenges in ultrasound processing.

UNIT IV **9 Hours**

ALTERNATIVE NON THERMAL PROCESSING TECHNIQUES

High Intensity pulsed light technology:- principles of PLT technology - Technological aspects of PLT - Effects of PLT technology on microorganisms and food quality. Ohmic Heating: Fundamentals of Ohmic Heating, Electrical Conductivity, Generic Configuration, Treatment of Products. Infrared Heating - Fundamentals, Basic laws for blackbody radiation; IR Heater, IR Emitters - Types and Selection Criteria, Applications and Effect on Foods

UNIT V **9 Hours**

PROCESSING TECHNIQUES BY ELECTROMAGNETIC ENERGY

Microwave heating and microwave drying: Microwaves - dielectric heating, dielectric properties of foods - thermal properties of foods - Recent developments in microwave heating - combined microwave-vacuum drying, microwave freeze-drying - applications. Radio frequency electric fields: equipment, applications for heating and drying, effect of radio frequency electrical field on inactivation of microorganisms.

Total: 45 Hours

Reference(s)

1. Emerging Technologies for Food Processing. Da-Wen Sun (Ed), Academic Press, 1 Edition, 2005.
2. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. Barbosa Canovas, CRC Press, 1st Edition, 2004.
3. Novel Food Processing Technologies. M. P. Cano, M. S. Tapia, and G. V. Barbosa Canovas, CRC Press, 1st Edition, 2004.
4. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.

22FD009 THERMAL PROCESSING TECHNIQUES 3 0 0 3

Course Objectives

- Understand the Socio-scientific discipline that operates in society to ensure the delivery of goods to the ultimate consumer in best condition.
- Impart knowledge on processing macromolecular organic compounds by chemical alteration.
- Learn about modern techniques of preserving food materials from various factors.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals and principles of thermal processing foods.
2. Analyze the importance of various thermal applications using steam/water and their effects on food.
3. Analyze the methodology and equipment applied on thermal processing methods using hot air.
4. Apply alternate thermal techniques to a food and analyze their hygienic and safety aspects.
5. Analyze thermal resistance and its kinetics on micro-organisms and its resistance.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	-		-	3							1	1
2	1	-	2	2	-	3								
3	1	3	-		-	3							2	2
4	2	1	-		-	3							1	1
5	2	-	1			3							2	2

UNIT I **9 Hours**

INTRODUCTION TO THERMAL PROCESSING TECHNIQUES

Introduction. Thermophysical Properties of Foods - Definition and Measurement. Dielectric Properties. Heat Transfer - Conduction, Convection and Radiation, Basic Heat transfer Modes, Heat Transfer with phase changes, Heat changes with Electromagnetic Waves, Mass Transfer - Molecular Diffusion, Convection Mass Transfer

UNIT II **9 Hours**

THERMAL PROCESSING USING STEAM OR WATER

Blanching - Theory, Methods, Equipment, Effect on Enzyme Inactivation, Testing the Effectiveness of Blanching. Pasteurization - Theory, Methods, Equipment, Effect on Foods. Sterilization - In-container sterilization (Retorting), Ultra High Temperature (UHT), canned foods, Process and Euipment, Effect on foods. Evaporation and Distillation - Theory, Equipment, Effect on Foods, Extrusion - Rheological Properties of food, Equipment, Applications, Effects on foods.

UNIT III **9 Hours**

THERMAL PROCESSING USING HOT AIR

Dehydration or Drying - Fundamental concepts, Drying characteristics, Moisture Sorption Isotherms, Method - Sun drying, Hot air Drying, Fludized bed drying, Spray drying, Freeze drying, Dielectric drying, Hybrid Drying technology. Baking and Roasting - Theory, Equipments, Effects on Physical properties and nutritional value

UNIT IV **9 Hours**

OTHER THERMAL PROCESSING METHODS

Frying - Shallow frying, Deep Frying, Equipment and design, Effect of Heat on oil, Effect of Heat on fried Foods. Cooking - Theory, Methods, Effect on nutritional value, Quality Retention. Safety Aspects of Thermal Processing - Legislation and codes of Practice, Implementation of GMP aseptic packaging, HACCP Techniques, Process Audit, Aspects of GMP, Thermal process Validation

UNIT V **9 Hours**

HEAT RESISTANCE OF MICROORGANISM

Introduction, Temperature Distribution and Heat Penetration, Kinetic of Reaction, Ball"s Formula, Thermal Death Time, Thermal Death Point, Heat Resistance of Microorganism, Heat Resistance of Enzyme, D value, Z value, F value, TDT curve & 12-D concept.

Total: 45 Hours

Reference(s)

1. P.J. Fellows, Food processing Technology: Principles and practice, Second edition, Wood head publishing limited, Cambridge, 2009.
2. Donald Holdsworth & Ricardo Simpson, Thermal Processing of Packaged Foods, Second Edition, Springer, 2015.
3. Da-Wen Sun, Thermal Food Processing, CRC Press, 2006.
4. P Richardson, Thermal Technologies in Food Processing, Woodhead Publishing Limited, Cambridge, 2001.

22FD013 TRADITIONAL CONFECTIONARIES 3 0 0 3

Course Objectives

- Understand the influence of sugar in confectionery
- Apply the principles of ingredients chemistry.
- Troubleshoot the problems faced during processing of various traditional confectioneries

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

Course Outcomes (COs)

1. Interpret the significance of bulk sweeteners used in confectionery
2. Assess the functional properties of confectionery ingredients.
3. Outline the production and quality parameters of sugar based confections
4. Analyse the ingredients and processing of aerated confections
5. Evaluate the stability of cocoa based products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2		2			2				2		
2	2	2										2		
3	2	2	2	2								2		
4	2	2	2									2		
5	2			2									2	

UNIT I **7 Hours**

BULK SWEETENERS

Significance of bulk sweeteners and application- Types of bulk sweeteners- Monosaccharides, Disaccharides, Invert sugar, Glucose syrup- Natural and alternative sweeteners- High-intensity sweeteners- Physicochemical properties and applications.

UNIT II **11 Hours**

INGREDIENTS CHEMISTRY AND FUNCTIONALITY

Fats and Oils-chemical properties, lipid oxidation, polymorphism, phase behaviour- Crystallization of fats; Modification technologies- hydrogenation, fractionation, inter-esterification; Emulsifier-uses, types, and applications; Starches - separation of starches, property of starches and modified starches; Protein- chemistry, functional properties, application in confections; Pectin - chemistry and analyses; Gums - agar agar, alginates, carrageenan, gum arabica, gum tragacanth, guar gum; Other ingredients.

UNIT III **9 Hours**

SUGAR BASED CONFECTIONS

Compressed tablets and Lozenges-introduction, formulation and ingredients, processing, product characteristics, problem and trouble-shooting; Hard candy- formulations and ingredients, processing, product characteristics, trouble-shooting; Fondants and Creams- introduction, formulation, ingredients, manufacturing, product characteristics and potential problems; Caramel, Fudge and Toffee - ingredients, mixing, emulsification, cooking and browning, cooling and forming, colour and flavor generation, microstructure, shelf-life, trouble shooting.

UNIT IV **9 Hours**

AERATED CONFECTIONS

Introduction, Ingredients - sweeteners, stabilizers, humectants, emulsifiers, organic acids, gelation aids, active ingredients - processing, physical properties and shelf-life, problems and trouble-shooting; Jellies, Gummies, Licorices, Chewing and Bubble gums - ingredients, processing, product features. Sugar and Sugar free panned confections- pre-coat materials, colours, flavors, glaze and polish, Sugar shell application, special decoration, multicomponent layering, micro-stricture, soft panned and hard panned candies.

UNIT V **9 Hours**

CHOCOLATE AND COMPOUND COATINGS

Introduction, Cocoa bean production, composition and quality aspects; Chocolate processing-Tempering, Forming; Chocolate characteristics; Stability and shelf-life; Compound coatings- formulation, manufacturing, applications, coating characteristics, shelf-life; Chocolate panning- operation, types, finishing, storage and handling.

Total: 45 Hours

Reference(s)

1. Richard W. Hartel, Joachim H. von Elbe Randy Hofberger. (eds), Confectionery Science and Technology, Springer, 2017.
2. Amerine, M.A.; Pangborn, R.M.; Roessler, E.B., Principles of Sensory Evaluation. Academic Press, New York, 1965.
3. Martens, M.; Dalen, G.A.; Russwurm, H. (eds): Flavour Science and Technology. John Wiley and Sons, Chichester, 1987.

22FD014 RHEOLOGICAL PROPERTIES OF BAKERY AND CONFECTIONERY PRODUCTS

3 0 0 3

Course Objectives

- Understand the concepts of Food Rheology and various methods to measure rheological & textural properties of Food
- Exemplify the concepts of dough rheology and effects of various factors on rheological and textural properties of dough.
- Grasp knowledge regarding various instruments used in determination of food rheology.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Summarize the food rheology and role of ingredients in rheology of bakery products.
2. Analyze and interpret rheological properties of bakery products.
3. Select the appropriate techniques in assessing rheological properties of bakery products.
4. Evaluate the various factors and working of equipment in rheological properties of bakery products.
5. Apply the concepts of various testing methods to estimate the rheological properties of bakery products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2		2	2
2	2	2									2		2	2
3	2	2									2		2	2
4	2	2									2		2	2
5	2	2									2		2	2

UNIT I **9 Hours**

INTRODUCTION TO FOOD RHEOLOGY

Food rheology concept, scope of food rheology, texture of foods-types of stress, types of strain, types of viscosity, modulus (young, shear, bulk), poisson"s ratio, definition and importance of texture, texture-related concepts. Determination of rheological properties and measuring methods: destructive and non-destructive measurements, creep recovery and stress relaxation, dynamic mechanical tests, Modeling food texture: introduction, factor affecting texture, models to predict texture.

UNIT II **9 Hours**

RHEOLOGICAL PROPERTIES OF SOLID FOOD

Rheological properties of solid food: deformation of material, viscoelastic behavior, Failure and glass transition in solid foods: failure in solid foods, glass transition of solid foods (measurement, factor affecting, importance), Texture of foods: compression, snapping-bending, cutting shear, puncture, penetration, texture profile analysis.

UNIT III **9 Hours**

BASIC APPROACHES TO RHEOLOGY OF DOUGH AND GLUTEN

Dough structure and basics of rheology. Creep and recovery, viscometry, stress relaxation, oscillatory measurements. Empirical and fundamental testing. Rheological behavior of dough and gluten. Rheological properties of dough from high extraction, whole wheat and composite flours. Importance of dough and gluten viscoelasticity in gas retention and bread making.

UNIT IV **9 Hours**

BAKERY INGREDIENTS, PROCESSING PARAMETERS AND DOUGH RHEOLOGY

Effects of water, yeast, oxidation and compounds with disulfide and thiol groups, sugar and emulsifiers on rheological properties of dough. Influence of proteins, gluten, starch, and enzymes on rheological properties of dough. Effects of mechanical work, mixing time and temperature on dough rheology.

UNIT V **9 Hours**

RHEOLOGICAL TESTING

Rheological methods- Fundamental testing and empirical methods, Rheological testing equipment, compression, penetration, modified penetrometers, transient tests, dynamic tests, extensional viscosity, dough testing instruments- farinograph, mixograph, extensograph, alveograph, amylograph.

Total: 45 Hours

Reference(s)

1. Rao, M. A., Rizvi, S. S. H. and Datta A. K. 2005. Engineering Properties of Foods: CRC Press.
2. Heldman, D. R. (2007). Food Process Engineering:AVI Publications.
3. Faridi, H. and Faubion, J. M. (1997). Dough Rheology and Baked Products: CBS Publications, New Delhi.

22FD015 DESIGN OF BAKERY AND CONFECTIONERY EQUIPMENT

3 0 0 3

Course Objectives

- Understand the working of Food Processing equipment and various parameters for designing Food processing equipment
- Analyze and evaluate the design concepts of both baking and confectionery equipment
- Simulating novel techniques and concepts to design an efficient baking and confectionery equipment.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Select food process equipment based on constructional and operational characteristics
2. Make use of sizing, construction and costing of food process equipment
3. Appraise the criteria for design of food process equipment
4. Evaluate the various factors and working of equipment in bakery and confectionery products.
5. Apply the concepts to design the equipment for bakery and confectionery products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2									2		2	2
2	2	2									2		2	2
3	2	2									2		2	2
4	2	2									2		2	2
5	2	2									2		2	2

UNIT I **9 Hours**

BASICS ABOUT FOOD PROCESSING EQUIPMENT

Construction characteristics. Operational characteristics- reliability, convenience, safety, instrumentation, ergonomics, efficiency, accuracy, environmental impact. Testing of equipment. Equipment specifications. Sizing and costing of Equipment, materials of construction, Fabrication of equipment- Strength of Construction, Fabrication and Installation of Equipment, Hygienic Design of Food Processing Equipment.

UNIT II **9 Hours**

DESIGN OF FOOD PROCESS EQUIPMENT

Heat exchangers- heat transfer factor. Baking oven - load of baking chamber, load by products, load by heat loss, total thermal load, types of heating source. Types of agitators. Power requirements for

agitation. Design of agitation system components-shaft design and agitator design. Challenges faced during design of equipment

UNIT III **9 Hours**

EQUIPMENT USED FOR BAKING

Measuring tools- dry measuring cup and liquid measuring cup, measuring spoon, scale thermometers-oven thermometers, candy thermometers, timer; Hand tools - rolling pin, whisk, cookie cutter; Baking pans-aluminum pan, insulated pan, disposable pan, muffin pan, loaf pan; Mixers - vertical mixers, spiral mixers, horizontal mixers, electric mixers - electric handheld mixers, electric stand up or table top mixer, dough sheeter, proofer, retarder, ovens- deck oven, rack oven, mechanical oven, convection oven; Kettles, fryers.

UNIT IV **9 Hours**

EQUIPMENT USED FOR CONFECTIONERY

Extruder, temper, enrober, pastry blender, pastry cutter, cooling simulator, chip depositor, rollers, frozen cone unit, feeder mixer, aeration and aroma system, filling and weighing station, melting tank, wafer & biscuit feeder, chocolate stringer, packaging equipment.

UNIT V **9 Hours**

ANALYSER FOR BAKING AND CONFECTIONERY PRODUCTS

Moisture test, grain hardness testing, viscograph, amylograph, farinograph, dough mixers, dividers, rounders, proofing, moulding, ovens, slicers, packaging materials and equipment, chocometer, chocoanalyser

Total: 45 Hours

Reference(s)

1. George D, Saravacos. Handbook of food processing equipment, 2nd Ed, Springer Science and Business Media, 2016.
2. Ed Bausbacher and Roger Hunt, Process plant layout and piping design, 1st Ed, New Jersey, 1993

22FD019 TEA AND COFFEE PROCESSING 3 0 0 3

Course Objectives

- To gain knowledge in tea & coffee cultivation, harvesting, production, processing and packaging.
- o assess the classification of tea & coffee and tea - coffee pharmacology.
- To characterize quality assurance and quality control of tea & coffee processing

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the importance of tea & coffee as a beverage in India.
2. Assess the different tea & coffee processing and production methods.
3. Predict the role of tea & coffee in pharmacology.
4. Compute the health effects of tea and coffee.
5. Analyze the quality assurance and quality control of tea and coffee.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1	-	1			1	1
2	1		2	2	2	1		2		1		-		
3	1		1	2	3	2		1		1			1	

4	2		2	2	2	1		1	-	1				
5	1		1	2	-	-		1		1				

UNIT I **9 Hours**

INTRODUCTION OF TEA

Introduction - History of the tea & coffee trade and its origin - Chemical composition - Climates of tea & coffee cultivation and harvesting process - Geographical distribution of tea plantations. Production - Morphology and anatomy - Classification - Health effects - By Products utilization of tea & coffee - Economics.

UNIT II **9 Hours**

PRODUCTION AND PROCESSING OF TEA LEAVES

Black tea - Green tea - Oolong tea. Chemistry of tea manufacturing and tea quality - Tea processing - Picking - Withering - Rolling/ Bruising - Fermentation - Fixation - Drying - Packaging. Equipment used in tea processing - CTC machine - Orthodox Machine. Biochemical changes during fermentation. Instant tea - Tea concentrates - Decaffeinated tea - flavored tea - Herbal tea. Storage of tea - Sorting and Grading of Tea.

UNIT III **9 Hours**

PROCESSING OF COFFEE

Introduction - Coffee fruit and morphology - Chemical composition and Nutritional value of coffee- Green coffee processing - Harvesting the cherries - Types of coffee - Processing the cherries - Wet and dry processing - Sorting- pulping- fermentation- Drying - Milling - Storage. Physiochemical changes during drying - Decaffeination. Instant coffee - Extraction and aroma recovery- Evaporation- Freeze drying- Spray drying and agglomeration

UNIT IV **9 Hours**

TEA AND COFFEE PHARMACOLOGY

Chemical composition of tea leaf and coffee - Inorganic constituents - Enzymes, Polyphenols, aromatic compounds. Pharmacology of tea and coffee. Biochemical changes during chemical withering - volatile flavor compounds - Chlorophyll, caffeine, lipids, catechins and enzyme activity- carotenoids. Bioavailability of antioxidants in tea and coffee. Focus on international works regarding health values on tea and coffee

UNIT V **9 Hours**

TEA AND COFFEE QUALITY TESTING, INSPECTION AND CERTIFICATION

Introduction to tea & coffee quality testing and analysis - Quality testing of tea & coffee - Physical appearance- color- size- flavor- Taste. Chemical- Microbial- sensory analysis. Other analysis includes testing for presence of chemicals - heavy metals- toxins. Quality assurance in tea & coffee industry- Importance of tea and coffee quality testing and analysis - Tea & coffee import and export - National and International bodies of tea & coffee quality testing and analysis.

Total: 45 Hours

Reference(s)

1. K.C.Willson. 1999.Crop production science in horticulture.CABl publishing, UK, 231p.
2. Ramaswamy Ravichandran.2000. Lipid Occurrence, distribution and degradation to flavor volatiles during tea processing. Food chemistry.68:7-13.
3. Dr.Balasubramaniam. 1995.Tea processing. Academic press, New Yor
4. Tea, In Health and Disease Prevention Edited by V. R. Preedy, Elsevier.
5. Tea Science and Human Health, TRA.
6. Coffee Processing by Products Edited by Galanakis & Charis Michel

22FD020 AROMATIC SPICES PROCESSING 3 0 0 3

Course Objectives

- To understand the fundamentals of aromatic spices and herbs
- To analyze the methods of processing for different aromatic spices
- To evaluate the processing and extraction techniques of Major and Minor spices

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
g. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
i. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.

Course Outcomes (COs)

1. Understand the scope, uses and functional properties of aromatic spices
2. Assess the post-harvest handling and standards of aromatic crops
3. Analyze the processing techniques and active compounds of the value added products
4. Compare the processing methods and extraction techniques of major spices
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	-	2		-	-						1	
2	1	2	-	2		-	-							
3	2	1	-	2	-	-	-		-	-				
4	3	2	1	2	-	-		-	-				1	

5	3	2	1	2	-	-	-	-	-	-			1	

UNIT I **9 Hours**

INTRODUCTION TO AROMATIC SPICES

Aromatic spice crops - Introduction , importance of spice crops - Present status and future prospects- classification - Production, consumption and processing- Under-utilized herbs and spices- Active plant constituents- Functional properties - Use of aromatic herbs and spices- Role of commodity boards and developmental institutions in plantation crops.

UNIT II **9 Hours**

MAJOR AROMATIC SPICE PROCESSING

Importance of aromatic spices- production and export status - stages and method of harvest of important spices - equipment used for threshing, shelling, decortications of spices- Processing and classification of cardamom- stages of harvest- Industrial processing of pepper, chemical composition, functional properties. Harvesting- packaging- processing of white pepper- wet and dry pulping and retting methods - Drying and Processing of turmeric, active compounds, value added products, applications- Processing of chilli- harvesting, drying, packaging and grinding- culinary applications.

UNIT III **9 Hours**

MINOR AROMATIC SPICE PROCESSING

Minor spices- Cumin, coriander, cinnamon, fenugreek, Garlic and clove- Processing. Functional properties - chemical composition- Quality issues- applications of minor spices. Processing of ginger- harvesting, washing, drying and packaging- quality aspects- processing and toxicology of clove, nutmeg and other minor spices. Packaging and storage of aromatic spices.

UNIT IV **9 Hours**

PRODUCTION TECHNOLOGY OF AROMATIC CROPS

Production technology, Post- harvest handling- Drying, Processing, Grading, Packing and Storage. Processing of value addition - Major chemical constituents of spice essential oils- oleoresins and essential oils - Method of manufacture - Chemistry of volatiles- Enzymatic synthesis of flavor identicals - Cryogenic grinding- advantages- refrigerant used- construction and working. Phytochemical extraction techniques- production technology- Distillation methods, advanced methods- Solvent extraction process of aromatic spices and herbs

UNIT V **9 Hours**

QUALITY INDICES OF AROMATIC SPICES

Introduction- Defining Quality- Major international quality specifications- Quality standard in aromatic spice products. GAP and GMP certification of organic products. Quality analysis- AGMARK and ASTA standards

Total: 45 Hours

Reference(s)

1. Spices: Morphology, History, Chemistry, J W Parry, Chemical Publishing Co., New York (1969)
2. Kumar, N., Abdul Khader, Rangaswami, P. and Irvadappan, 1993, Introduction to spices, plantation crops, Medicinal and Aromatic plants, Rajalakshmi Publication
3. Peter, Kuruppacharil V., ed. Handbook of herbs and spices: volume 3. Woodhead publishing, 2006.
4. Panda, H. Handbook on spices and condiments (cultivation, processing and extraction). ASIA PACIFIC BUSINESS PRESS Inc., 2010
5. Pruthi, J. S. "Spices and condiments National Bank Trust." New Delhi, India 226 (1976)

22FD021 PROCESSING OF CHOCOLATE AND ITS PRODUCTS

3 0 0 3

Course Objectives

- To gain knowledge in chocolate and its products
- To know about processing, storage and packaging of different types of chocolate and its products
- To characterize the production and manufacturing process of cocoa and chocolate

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand scope, processing and production of cocoa and chocolate
2. Apply the processing methods of chocolate and its products
3. Analyze different types of cocoa and chocolate
4. Find the chocolate base products and its manufacturing process
5. Analyze the various chocolate based confectionery products

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO COCOA

Introduction of chocolate - History & Development - Sources - Cocoa beans, types of cocoa - Morphological and varietal characteristics of cocoa - Pests and diseases of cocoa - Cocoa crop protection - Post- Harvest Treatments - Cocoa bean quality. Flowering and pod development - Environmental aspects of cocoa cultivation.

UNIT II **9 Hours**

POST HARVEST TREATMENTS OF COCOA

Introduction and techniques for improving cocoa bean quality - Verities of cocoa - Harvesting - Fermenting and drying. Fermentation techniques - Changes during fermentation of cocoa beans - Biochemical changes - Microbial succession during fermentation - Changes in enzymatic activities. Quality assessment of cocoa - Contaminants and residues - Cocoa butter hardness. Cocoa bean quality and selection - Steps in cocoa processing - cocoa powder production.

UNIT III **9 Hours**

CHOCOLATE MANUFACTURING AND ITS TYPES

Introduction to chocolate manufacture - Chocolate manufacturing process - Mixing - Refining - Conching - Principle - Phases - Conching machines. Tempering and Lipid crystallization, polymorphism of cocoa butter, Measurement of temper, Tempering machines - Moulding and enrobing, Cooling - Demoulding - Wrapping/ Packaging. Chocolate quality and defects - Fat bloom - Sugar bloom

UNIT IV **9 Hours**

PROCESSING TECHNOLOGY OF CHOCOLATES

Particle size reduction - Principles, equipment, cocoa nib grinding. Particle size reduction and chocolate flow properties. Flavor development in cocoa and chocolate - Fermentation - Roasting - Drying - Conching. Chocolate flow properties - Non Newtonian flow - Sample preparation and measurement procedures. Chocolate panning - Methods - Process. Packaging in confectionery industry - Metal cans - Paper and associated materials - Types of paper - Metal foils - Transparent films - flow wrap machinery and sealing.

UNIT V **9 Hours**

CHOCOLATE AND ITS PRODUCTS

Types of chocolates and its manufacturing processes - Milk chocolate - White chocolate - Dark chocolate - Semisweet chocolate - Bittersweet chocolate - Unsweetened chocolate - Sweet Garman chocolate - Couverture chocolate - Ruby chocolate - Cocoa powder - Cocoa butter - Application, Advantages, disadvantages of different varieties of chocolate. Nutritional and health aspects of chocolate - Uses and applications of chocolate.

Total: 45 Hours

Reference(s)

1. Flavour Development in Cocoa and Chocolate (Pages: 169-191) by Dr., Dr.-Ing. G. Ziegleder
2. Beckett, Steve T., ed. Industrial chocolate manufacture and use. John Wiley & Sons, 2011
3. Afoakwa, Emmanuel Ohene. Cocoa production and processing technology. CRC Press, 2014
4. Production and Quality Standards of Cocoa Mass, Cocoa Butter and Cocoa Powder (Pages: 121-141) by H. J. Kamphuis M.Sc., Ph.D
5. Chocolate Science and Technology by Afoakwa, Emmanuel Ohene

22FD025 NATIONAL AND INTERNATIONAL FOOD LAWS

3 0 0 3

Course Objectives

- To gain knowledge in food safety laws and regulations.
- To be aware of the regulatory and statutory bodies in national and international level.
- To characterize different type of food hazards, physical, chemical and biological in the industry and food service establishments.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the importance of the food laws and regulations in India and aboard.
2. Analyze the regulations followed by the food safety and standards act followed in India.
3. Predict the role of food authority and rules of FDA in USA.
4. Understand the federal systems followed in Europe.
5. Analyze the legislative process opted by China.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	-	2	2	2	2		2		2	2	2		
2	3		2	2	2	2		2		2				
3	2		2	2	2	1		1		2	1			
4	1		2	2	2	1		3		2				

5	1		2	2				2		1				

UNIT I **9 Hours**

FOOD SAFETY AND INTERNATIONAL FOOD STANDARDS

Food-borne hazards and risks; Codex Alimentarius Commission and application of risk analysis in food standard setting; Codex Standards in international food trade and national food legislation.

UNIT II **9 Hours**

FOOD AUTHORITY IN INDIA

Food safety and Standards Act-organizational chart-role of individual authority-Licensing and registration of food business -Food safety officer and their powers- Offences and penalties- Laws relating to Food Processing Industries in India-FPO,MMPO, PFA, AGMARK, Essential Commodities Act, BIS.

UNIT III **9 Hours**

FOOD LAW AND REGULATION IN USA

Major food legislation in USA: Food, Drug and Cosmetic Act (FD&C)-Food Safety Modernization Act (FSMA)and relevant sections of the Code of Federal Regulations (CFR)-Roles of Food and Drug Administration (FDA)-The United States Department of Agriculture (USDA) and other government agencies in food safety control.

UNIT IV **9 Hours**

EUROPEAN FOOD LAWS AND REGULATIONS

European treaties-Member states of the EU, EU regulatory institutions-European Commission, Food legislation in the European Union (EU) and other countries; the roles of European Food Safety Authority (EFSA) and government agencies of EU member countries in food safety control.

UNIT V **9 Hours**

FOOD LAWS AND REGULATIONS IN CHINA

Major principle food legislation: Food Safety Law and related Laws; Subsidiary legislation including rules and regulations, National standards on labelling, food additives, food quality, food hygiene etc.; Roles of various government agencies in the food safety control system.

Total: 45 Hours

Reference(s)

1. Mehta R. and George J. "Food Safety Regulation Concerns And Trade- The Developing Country Perspective", Macmillan India Ltd., New Delhi. 2005.
2. Mehta, R and George, J. "Food Safety Regulations Concerns and Trade". The Developing Country Perspective", Macmillan, 2005
3. Vetter, J.L. 1993. "Food Labeling- Requirements for FDA Regulated Products" American Institute of Baking, Manhattan, Kansas.
4. Goodburn K. (Ed) 2005. EU Food Law: A Practical Guide, CRC Press Boca Raton, Boston, New York, Washington DC., Woodhead Publishing Limited, Cambridge, England.

22FD026 RISK ANALYSIS 3 0 0 3

Course Objectives

- To gain knowledge in hazard identification.
- To be aware of the regulatory aspect of risk analysis.
- To characterize different aspects of riak analysis, risk management, risk assessment and risk communication.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the importance of the risk analysis in relation with food safety hazards.
2. Analyze the principles of risk analysis in decision making.
3. Predict the role of risk management in managing food safety.
4. Understand the concept of risk assessment.
5. Analyze the priority of risk communication and its principle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2	2	2		2		2	2	2		
2	2		2	2	2	2		2		2				
3	2		2	2	2	2		2		2	2			
4	2		3	2	2	2		1		2				
5	1		2	2				1		2				

UNIT I **9 Hours**

INTRODUCTION TO RISK ANALYSIS

Definitions, Risk assessment (Hazard identification, Hazard characterization, Exposure assessment (deterministic and probabilistic approach), Risk characterization, Chemical risk assessment in foods (including aggregated and cumulative assessment), Microbial risk assessment in foods.

UNIT II **9 Hours**

REGULATORY PROCESS OF RISK ANALYSIS

Introduction to risk analysis, Principles of risk management decision-making, General principles of food law, Risk analysis and WTO, How risk analysis fits into food safety law systems.

UNIT III **9 Hours**

RISK MANAGEMENT

Risk manager"s role and how we think about things, Risk management frameworks and models, Principles of decision-making and the constraints, Dealing with uncertainty of risk assessment, Risk management options and decision, Interactions between risk manager and risk assessor.

UNIT IV **9 Hours**

RISK ASSESSMENT

Context of food safety risk assessment, Risk assessor"s toolbox, Application to food-borne and related hazards, Components of risk assessment.

UNIT V **9 Hours**

RISK COMMUNICATION

Principles of risk communication, Establishing your goal, Risk perception and understanding your audience, Creating your message, Communication in action

Total: 45 Hours

Reference(s)

1. Hoboken, N.J. (2011) Risk assessment : theory, methods, and applications
2. Hoboken, N.J. (2011) Risk and crisis communications methods and messages

22FD027 FOOD ADULTERATION AND ITS CONTROL

3 0 0 3

Course Objectives

- To gain knowledge about adulteration in food.
- To be aware of adulterants and its impact on health.
- To ensure the safety, quality and authenticity of food products.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
j. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Find the types of adulterants in food.
2. Analyze the detection methods of adulterant in different food products.
3. Predict the food laws and procedures on adulteration.
4. Understand the strategies to control food adulteration.
5. Educate the consumer by providing appropriate education and public awareness.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2	2	2		2		2	1	2		
2	2		2	2	2	2		2		2				
3	2		2	2	2	1		2		1	2			
4	2		2	2	2	2		2		2				
5	3		1	1				3		1				

UNIT I **9 Hours**

INTRODUCTION TO ADULTERATION

Common Foods subjected to Adulteration-Adulteration-Definition-Types; Poisonous substances, Foreign matter, cheap substitutes, Spoiled parts. Adulteration through Food Additives-Intentional and incidental. General Impact on Human Health.

UNIT II **9 Hours**

METHODS OF DETECTION OF ADULTERATION

Means of Adulteration Methods of Detection Adulterants in the following Foods; Milk, Oil, Grain, Sugar, Spices and Condiments, Processed Food, Fruits and Vegetables. Additives and Sweetening agents (at least three methods of detection for each food item).

UNIT III **9 Hours**

PRESENT LAWS AND PROCEDURES ON ADULTERATION

Highlights of Food Safety and Standards Act 2006 (FSSA)-Food Safety and Standards Authority of India-Rules and Procedures of Local Authorities. Role of Voluntary Agencies such as, Agmark, ISI.

UNIT IV **9 Hours**

QUALITY CONTROL ROLE ON FOOD ADULTERANT

Quality control laboratories of Companies, Private testing laboratories, Quality control laboratories of Consumer co-operatives.

UNIT V **9 Hours**

CONSUMER EDUCATION

Consumer Education, Consumer"s problems, rights and responsibilities, COPRA 2019- Offenses and Penalties- Procedures to Complain- Compensation to victims.

Total: 45 Hours

Reference(s)

1. A first course in Food Analysis -A.Y. Sathe, New Age International (p) Ltd, 1999
2. Food Safety, case studies-Ramesh.V.Bhat,NIN,1992.
3. Rapid Detection of Food Adulterants and Contaminants-Theory and Practice, Shyam Narayan Jha and Pranay, 2016.

22FD028 FOOD SAFETY MANAGEMENT SYSTEMS 3 0 0 3

Course Objectives

- To describe the importance of food safety management systems (FSMS).
- To apply the HACCP principles to develop and implement a HACCP plan
- To implement GMPs in food production facilities.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

h.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

j.Communication: Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

m. Students will be able to execute innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Identify the benefits of implementing an FSMS.
2. Identify and assess hazards in food production processes.
3. Define GMPs and explain their importance in food safety.
4. Understand the steps involved in a food recall.
5. Understand the requirements of these regulations and standards.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1		1		1			1	1
2	1		2	2	2	1		2		1				
3	1		1	2	3	2		1		1			1	
4	2		2	2	2	1		1		1				
5	1		1	2				1		1				

UNIT I **9 Hours**

INTRODUCTION TO FOOD SAFETY MANAGEMENT SYSTEM

Food safety - General principles of food safety. Characterization of food Hazards - physical, chemical and biological. Food spoilage and food borne infection hazards-sources of food spoilage and

microorganisms- microbial problems in food safety-food toxicants and food poisoning - prevention. Cross contamination,

UNIT II **9 Hours**

FOOD QUALITY AND QUALITY EVALUATION OF FOODS

Food Quality - its need and its role in Food Industry. Food Quality and Quality Attributes-Classification of Quality Attributes and their role in food Quality. Quality Assessment of Food materials- Sensory Evaluation of Food Quality. Requirements for conducting Sensory Evaluation, Methods of Sensory Evaluation.

UNIT III **9 Hours**

QUALITY CONTROL

Objectives, Importance and Functions of Quality Control. Quality control, principles of quality control - raw material control, process control, finished product inspection, process control, quality problems and quality improvement techniques- mechanization, future of quality control, Total quality management. Objective/Instrumental analysis of Quality Control.

UNIT IV **9 Hours**

NATIONAL AND INTERNATIONAL FOOD LAWS AND STANDARDS

Standards for food packaging and labeling - FSSAI, Bureau of Indian Standards (BIS), Agricultural Grading and Marketing (AGMARK), The Agricultural and Processed Food Product Export Development Authority (APEDA), MPEDA. Food and Drug Administration Act (FDA), International Organization for Standards (ISO) and its implication, Generally recognized as safe (GRAS), European Council (EU) , Codex Alimentarius Commission (CAC), Total Quality Management (TQM), Good Manufacturing Practices (GMP), Good Agricultural Practices(GAP), and Good Hygienic Practices (GHP) , GMP, Hazard Analysis Critical Control Point (HACCP), FSMA, Legal Metrology Rules, Food Safety Standards for Organic foods, GFSi, HALAL and KOSHE.

UNIT V **9 Hours**

QUALITY CONTROL MEASURES IN INDUSTRIAL AND MARKETING CENTRES

Quality control system in storage, Quality control aspects in food industries, Importance of quality control in marketing of Food products - domestic and export markets. International standards for export and quarantine requirements for export of Agricultural and Horticultural produce.

Total: 45 Hours

Reference(s)

1. "Food Safety Management Systems: A Practical Guide for the Food Industry" by Bryan Bedford and Richard Walls
2. "HACCP: A Practical Guide" by Frank Busta, Michael Davidson, and John Lake
3. "Good Manufacturing Practices for Food Industries" by C.L. Lawrie and A.L. Griffiths
4. "Food Recall: A Practical Guide" by Bill Marler and David S. Acheson
5. "Food Safety Regulations: A Guidebook for the Food Industry" by Richard H. Linton and Michael J. Sofos.

22FD031 MICROBIAL PRESERVATION AND PROCESSING

3 0 0 3

Course Objectives

- Understand and identify the important pathogens and spoilage microorganisms in Foods and the conditions under which they grow (covered in detail)
- Impart knowledge on role and significance of microrganisms in development of fermented food products
- Learn about the general characteristics of Bacteria, Fungi, Virus, Protozoa and algae also morphological characteristics important in Food Bacteriology

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Apply the functions of food microbes for manufacturing fermented foods
2. Analyze the importance of as food safety to act as a mode of transmission of various infectious agents.
3. Find the importance of microbes in producing pro and prebiotic food products
4. Apply the new innovation in developing new preservative techniques
5. Analyze the response to the changes in processing foods by modern preservation techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1		3	2							-	
4	2	2	2		2	1								
5	1	2	1		-	-								

UNIT I **9 Hours**

INTRODUCTION AND SCOPE OF FOOD MICROBIOLOGY

Introduction of microbiology-General characteristics of Bacteria, Fungi, Virus, Protozoa and algae-Importance of microorganisms in Food- Food as a substrate for micro organism- Classification of

Nomenculture of Micro organism- Factor affecting the growth of micro organisms in Food, Feed and Fodder- Normal microflora of some common foods

UNIT II **9 Hours**

MICROBIAL GROWTH RESPONSE IN THE FOOD ENVIRONMENT

Microbial Growth Characteristics - Factors infuencing Microbial Growth in Food- Microbial Metabolism of Food components- Microbial Sporulation and Germination- Microbila stress response in Food Environment

UNIT III **9 Hours**

BENEFICIAL USES OF MICROORGANISMS IN FOOD

Microorganisms used in Food Fermentation- Microbiology of Feremented Food Production- Intestinal Beneficial Bacteria- Food Bio preservatives of Microbial origin- Food Ingredients and Enzymes of Microbial Origin

UNIT IV **9 Hours**

MICROBIAL FOODBORNE DISEASES

Important Factors in Microbial Food spoilage- Food Spoilage by Microbial Enzymes- Indicators of Microbial Food spoilage- Microbial Foodborne diseases- Foodborne Intoxications- Foodborne infections- Foodborne Toxicoinfections-Opportunistic pathogens, Parasites, and Algal Toxins- Indicators of Bacterial Pathogens

UNIT V **9 Hours**

CONTROL OF MICROORGANISMS IN FOODS

Control of Access(cleaning and sanitation)- Physical removal- heat- Low temperature- reduced Aw- Low pH and organic acids- Modified Atmosphere (or Reducing O-R Potenetial)- Antimicrobial Preervatives- Novel Processing Technologies- Hurdle concept- Detection of Microorganisms in Food and Food environment

Total: 45 Hours

Reference(s)

1. Adams, M. R. and M. O. Moss. 2008. Food Microbiology, 3rd Edition. Cambridge: The Royal Society of Chemistry (RSC Publishing).
2. Benwart, G. J. 1987. Basic Food Microbiology. New Delhi: CBS Publishers & Distributors.
3. Blackburn, Clive de W. 2006. Food Spoilage Microorganisms. Cambridge: Woodhead Publishing.
4. Deak, T. and L. R. Beuchat. 1996. Handbook of Food Spoilage Yeasts. US: CRC Press.
5. Frazier, William C. and Dennis C. Westhoff. 1988. Food Microbiology. New York: McGraw-Hill.

22FD032 BIOPROCESS TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the fundamentals of bioreactor design for efficient production of biomolecules and monitoring of bioprocesses in industry.
- To plan a research career or to work in the biotechnology industry with a strong foundation about bioreactor design and scale-up
- To apply modelling and simulation of bioprocesses to reduce costs and to enhance the quality of products and systems.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand the bioprocess and sterilization kinetics.
2. Apply stoichiometric calculations to predict bioprocess efficacy.
3. Analyze the productivity in a bioreactor for the given metabolite
4. Evaluate the structured models and metabolic pathways in product formation.
5. Evaluate simulated bioprocesses for automatic control with reduced costs and enhanced product quality.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	3									1		
2	2	1	3									2		
3	2	2	3									1		
4	1	2	3	-								2		
5	1				-							1		

UNIT I **9 Hours**

MEDIA DESIGN AND STERILIZATION

Basic configuration of bioreactor and ancillaries, Medium requirements for bioprocesses, Medium formulation of optimal growth and product formation, Medium optimization methods, Thermal death kinetics of microorganisms, Heat and filter sterilization of liquid media, Air sterilization,Design of sterilization equipment.

UNIT II **9 Hours**

METABOLIC STOICHIOMETRY AND ENERGETICS

Stoichiometry of cell growth and product formation, Elemental balances, Degrees of reduction of substrate and biomass, Available electron balances, Yield coefficients of biomass and product formation, Energetic analysis of microbial growth and product formation, Thermodynamic efficiency of growth.

UNIT III **9 Hours**

BIOREACTOR DESIGN AND SCALE UP

Batch, Fed batch and continuous cultivation.Feeding Strategies and Microbial Kinetics, Rheology of fermentation fluids, Transport phenomena in bioprocess systems, Oxygen mass transfer rate determination methods, Stirred tank reactor, Plug flow reactor, Fluidized bed reactor, Bubblecolumn, Air lift reactor, Photo bioreactor, Bioreactors on a chip, Scale up criteria for bioreactors.

UNIT IV **9 Hours**

MODELLING OF BIOPROCESSES

Monod model, Multiple substrate models, Models of growth associated product formation kinetics, Compartmental models, Models of cellular energetics and metabolism, Single cell models,Modelsof gene expression and regulation, Models of plasmid expression and replication.

UNIT V **9 Hours**

BIOPROCESS SIMULATION

Major subsystems of a process simulator, General architecture of on-line simulation system,Dynamic simulation of batch, fed batch, steady and transient culture metabolism,Model simulation usingMATLAB-SIMULINK and ISIM software packages..

Total: 45 Hours

Reference(s)

1. Michael L. Shuler and FikretKargi, Bioprocess Engineering - Basic Concepts, Pearson New International Edition, 2014.
2. Pauline M. Doran, Bioprocess Engineering Principles, Academic Press Limited, 2013.
3. Peter F. Stanbury, Allan Whitaker and Stephen J. Hall, Principles of Fermentation Technology, Butterworth Heinemann publications, 1995.
4. Harvey W. Blanch, S. Douglas and Clark, Biochemical Engineering, New York: Marcel Dekker Inc., 1997.
5. Shijie Liu, Bioprocess Engineering - Kinetics, Sustainability, and Reactor Design, Elsevier Science, 2013.

22FD033 FOOD ALLERGENS AND TOXICOLOGY 3 0 0 3

Course Objectives

- Familiarize with hazards, and toxicity associated with food and their implications for health.
- Know the various kinds of allergens and basis of allergic reactions
- The objective of the course is to introduce food related toxicological compounds in different foods
- To understand the protocols of sampling techniques in food toxicology measurements
- To gain the knowledge on level of processing of food to destroy allergens / toxins
- Creates an awareness to choose food with highly safe

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Awareness about the different types of allergens and Natural toxins associated with food
2. Understand about food toxicology and its hazards
3. Understand about food sensitivity and allergy
4. Analyze food toxin in food samples
5. Adapting toxin formed during processing and controlling

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	2		2	1							1	1
2	1	2	2		2	1								
3	1	2	1	-	3	2							1	
4	2	2	2		2	1								
5		2	1			-								

UNIT I **9 Hours**

INTRODUCTION OF FOOD TOXICOLOGY AND ALLERGENS

Definition and need for understanding food toxicology; Hazards - Microbiological,nutritional and environmental. Basics of immune resources - humoral and cell media resources.Allergen and mechanism of allergic resources

UNIT II **9 Hours**

FOOD ALLERGY AND SENSITIVITY.

Natural toxins in food: natural toxins of importance in food-toxins of plant and animal origin;microbial toxins (e.g., bacterial toxins, fungal toxins and Algal toxins), natural occurrence,toxicity and significance, determination of toxicants in foods and their management.

UNIT III **9 Hours**

PRINCIPLES OF TOXICOLOGY

Natural food toxicants - toxicity of mushroom alkaloids, seafood, vegetables, fruits, pulses,and antinutritional compounds. Biological factors that influence toxicity, toxin absorption intheG.I.track, Industrial microflora, blood, brain barrier, storage and excretion of toxins

UNIT IV **9 Hours**

DETERMINATION OF TOXICANTS IN FOOD SAMPLING

Quantitative and qualitative analysis of toxicants in foods; Biological determination of toxicants Assessment of food safety.Risk assessment and risk benefit indices of human
exposure, acute toxicity, mutagen city and carcinogenicity, reproductive and developmental toxicity, neurotoxicity and behavioral effect, immunotoxicity.

UNIT V **9 Hours**

TOXICANTS FORMED DURING FOOD PROCESSING

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavor enhancers, food colors, indirect additives, residues and contaminants, heavy metals, other organic residues and packaging materials. Toxicity of heated and processed foods, food carcinogens and mutagens - Polycyclic aromatic hydrocarbons, N - nitrosamines, Acrylamide
and their mode of action

Total: 45 Hours

Reference(s)

1. Helferich,W.,and Winter,C.K " Food Toxicology",.CRC Press,LLC.Boca Raton,F.L.2007.
2. Shimbamoto,T., and Bjeldanes, L. " Introduction to Food Toxicology", 2009, 2nd Edition.Elsevier Inc.,Burlington,M.A.
3. Watson, D.H. "Natural Toxicants in Food",CRC Press,LLC,Boca Raton,FL1998

22FD037 FRUIT SCIENCE 3 0 0 3

Course Objectives

- Understand and analyze the fundamentals of horticulture in fruit production.
- Impart knowledge on role and significance of breeding in development of fruits.
- Learn about the general characteristics of tropical, subtropical and temperate fruits and also its post-harvest practices.

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
h. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
k. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply the set one's own work, as a member and leader in a team, to manage projects and in multi-disciplinary environments.
l. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Understand the basic fundamentals of horticulture.
2. Analyze the techniques of breeding fruit crops and its importance.
3. Identify and analyze the tropical and subtropical fruits and its cropping system
4. Assess the temperate fruits production and varieties
5. Evaluate the post-harvest practices of fruits and packaging systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1	1		2			3						
2	3	3												
3	3	3	3	3	2									
4			2	3	3			1			2	2		3
5		3		3	2									

UNIT I **9 Hours**

FUNDAMENTALS OF HORTICULTURE

Classification of horticulture crops and nutritive value, area and production, exports and imports, fruit and vegetable zone of India - soil and climate, planning and layout, planting systems and planting densities. Production and practices for fruit, vegetable and floriculture crops. Types and methods of pruning and training of fruit crops, types and use of growth regulators in horticulture, water management - irrigation methods, weed management, fertility management, cropping systems, Rejuvenation, Principles of organic farming

UNIT II **9 Hours**

BREEDING OF FRUIT CROPS

Origin and distribution, Taxonomical status - species and cultivars, cytogenetic, genetic resources, blossom biology, breeding systems, breeding objectives, ideotypes, approaches for crop improvement - introduction, selection, hybridization, mutation breeding, polyploid breeding, rootstock breeding, improvement of quality traits, resistance breeding for biotic and abiotic stresses, biotechnological interventions.

UNIT III **9 Hours**

TROPICAL AND SUBTROPICAL FRUITS

Commercial varieties of regional, national and international importance, recent trends in propagation, rootstock influence, planting systems, cropping systems, nutrient management, water management, fertigation, bioregulation, physiology of flowering, maturity indices, harvesting and ripening techniques; Crops: Apple, pear, quince, grapes, Plums, peach, apricot, cherries, Litchi, loquat, persimmon, kiwifruit, strawberry, Nuts- walnut, almond, pistachio, pecan, hazelnut, Minor fruits- mangosteen, carambola, bael, wood apple, fig, jamun, rambutan, pomegranate.

UNIT IV **9 Hours**

TEMPERATE FRUITS

Classification of temperate fruits - detailed study of areas, production, varieties, climate and soil requirements, propagation, planting density, cropping systems, nutrient and weed management - harvesting, post-harvest handling and storage of apple, pear, peach, apricot, cherry, persimmon, strawberry, kiwi, Queens land nut (Mecademia nut), almond, walnut, pecan nut, hazel nut and chest nut.

UNIT V **9 Hours**

POST HARVEST TECHNOLOGY

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and textural changes, respiration, transpiration; Physiology and biochemistry of fruit ripening, ethylene evolution and ethylene management, factors leading to post-harvest loss, pre-cooling; Treatments prior to shipment, viz., chlorination, waxing, chemicals, biocontrol agents and natural plant products. Methods of storage- ventilated, refrigerated, MAS, CA storage, physical injuries and disorders; Packing methods and transport, principles and methods of preservation, food processing methods, processing waste management, food safety standards.

Total: 45 Hours

Reference(s)

1. Prasad and Kumar, 2014. Principles of Horticulture 2nd Edn. Agrobios (India).
2. Neeraj Pratap Singh, 2005. Basic concepts of Fruit Science 1st Edn. IBDC Publishers.
3. Gardner/Bardford/Hooker. J.R., 1957. Fundamentals of Fruit Production. Mac Graw Hill Book Co., New York.
4. Mukhergee,S.K. and Majumdar,P.K.1973.Propagation of fruit crops. ICAR, New Delhi.
5. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

22FD038 POST-HARVEST MANAGEMENT OF FRUITS AND VEGETABLE

3 0 0 3

Course Objectives

- To provide basic knowledge of postharvest processing methods and processes involved in post- harvest loss reduction.
- To introduce postharvest management practices which are eco-friendly and sustainable by integrating them with existing modern technologies.
- To encourage students in product development, conversion of fresh produce to processed form for value addition (nutritive and economic value).s

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
m. Students will be able to conduct innovative and high-quality research to solve emerging problems in food technology by applying scientific knowledge.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Application of postharvest technologies in their career through practical knowledge
2. Identifying and providing inputs to mitigate postharvest losses during cool chain management.
3. Providing skill on postharvest loss reduction through processing of fruits and vegetables.
4. Facilitating the students with knowledge and activities of food processing industries and also drive towards entrepreneurship.
5. Applying novel packaging techniques and improve the shelf-life of the horticulture produce.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	1	2	1							1	1
2	1		2	2	2	1								
3	1		1	2	3	2							1	
4	2		2	2	2	1								
5	1		1	2										

UNIT I **9 Hours**

PRINCIPLES OF POST-HARVEST TECHNOLOGY

Introduction, History and role of post-harvest technology; principles and methods of food preservation.
Post-harvest handling (harvesting, precooling, sorting, grading and packaging) of perishables. Food

storage systems; ripening and senescence of horticultural crops; Post harvest treatment for quality retention of horticultural crops; spoilage of fruits & vegetables, methods to reduce decay. Processing of
fruit and vegetables.

UNIT II **9 Hours**

PRE-HARVEST PHYSIOLOGICAL ASPECTS RELATED TO POST-HARVEST MANAGEMENT OF HORTICULTURAL PRODUCE

Introduction, Growth and development - definition, parameters of growth and development. Role of environmental factors and physiological processes on post-harvest life and quality. Physiological changes associated with ripening and seed development, preharvest factors affecting ripening and spoilage. Influence of plant growth regulators as pre harvest application on post-harvest storage life and
quality. Growth and developmental processes during stress manipulation of developing crop.

UNIT III **9 Hours**

POST-HARVEST PHYSIOLOGY AND BIOCHEMISTRY OF FRUITS AND VEGETABLES

Introduction, Structure and composition of fruits and vegetables, postharvest factors affecting physiology and biochemical constituents. Maturity and ripening processes and factors affecting them. Presence of constituents and their changes during development; maturation and ripening of fruits and vegetables; Biosynthesis of ethylene and its regulation, Ethylene action and ripening processes. Regulation of ripening and senescence of fruits and vegetables.

UNIT IV **9 Hours**

POST-HARVEST TECHNOLOGY OF VEGETABLE CROPS

Scope and importance of post-harvest management of vegetables; Nature and causes of postharvest losses; Harvesting methods, tools, harvesting practices for specific market requirements; pre cooling methods; grading, washing, pack house operations, pre-treatments, chemicals, wax coating, edible coating, pre-packaging and irradiation; packaging of vegetables, packaging materials; Storage methods
and Storage disorders, post-harvest diseases and pests - prevention from infestation.

UNIT V **9 Hours**

POST-HARVEST TECHNOLOGY OF FRUIT CROPS

Scope and importance of post-harvest management of fruits; Factors leading to post-harvest losses; Harvesting methods, tools, harvesting practices for specific market requirements; Pre cooling methods;
grading, washing, pack house operations, pre-treatments prior to shipment; Pre-packaging and irradiation, packaging of fruits, packaging materials; Storage methods and storage disorders; quality evaluation, principles and methods of processing and preservation.

Total: 45 Hours

Reference(s)

1. Sudheer, K.P. and V.Indira. 2007. Post-harvest technology of horticultural crops. New India Publishing Agency, New Delhi.
2. Verma, L.R. and V.K. Joshi. 2000. Post-harvest technology of fruits and vegetables, Handling, Processing, Fermentation and Waste Management. Indus Publishing Company. New Delhi.
3. Chadha K.L. 2009. Handbook of Horticulture. IARI Publications, New Delhi.
4. Thompson, A.K. 1996. Post harvest Technology of Fruits and Vegetable. Blackwell science ltd. London

22FD039 FRUIT AND VEGETABLE PROCESSING 3 0 0 3

Course Objectives

- Implement speccific Post harvest handling Technique for storage and transport of fruits and Vegetables
- Apply preservation techniques to produce value added fruits and vegetable products
- Learn the Industrial scale Processing and Preservation methods to extend the shelflife of fruit and Vegetable commodities

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
b. Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
c. Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
n. Practical and research training imparted to the students will pave way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Implement low temperature, modified atmosphere and controlled atmospheric storage methods for storage of fruits and vegetables
2. Produce value added products from fruits and vegetables by using suitable preservation method (sugar, salt or dehydration)
3. Produce dehydrated fruits and vegetables
4. Apply minimal processing and fermentation methods to produce value added products from fruits and vegetables
5. Plan to produce canned and bottled fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1				2								1
2	2	-			2									-
3	2	1		2										1
4	2		2	1										1
5	2	-		2	2									2

UNIT I **9 Hours**

INTRODUCTION TO FRUIT AND VEGETABLE TECHNOLOGY

Introduction to Fruit and Vegetable Technology-Overview of the fruit and vegetable industry Importance of fruit and vegetable processing-Historical perspective and technological advancements-Harvesting and Post-Harvest Handling- Harvesting techniques and considerations

UNIT II **9 Hours**

POST-HARVEST MANAGEMENT OF FRUITS AND VEGETABLES

Post-harvest physiological changes and factors affecting shelf life handling, sorting, and grading of fruits and vegetables- Preservation and Storage

UNIT III **9 Hours**

PROCESSING AND PRESERVATION OF FRUITS AND VEGETABLES

Principles of preservation: refrigeration, controlled atmosphere storage- Cold storage technology and its applications- Packaging materials and methods for fruits and vegetables- Processing Techniques-Drying and dehydration processes Canning and bottling-Freezing and refrigeration Juicing and extractiontechniques

.

UNIT IV **9 Hours**

QUALITY AND SAFETY STANDARDS IN FRUIT AND VEGETABLE PROCESSING

Quality Control and Food Safety-Quality assessment parameters and techniques principles in fruit and vegetable processing- Food safety regulations and standards

UNIT V **9 Hours**

EMERGING TRENDS IN FRUIT AND VEGETABLE TECHNOLOGY

Emerging Trends and Future Directions-Innovations in fruit and vegetable processing technologies-Sustainable practices in fruit and vegetable technology

Total: 45 Hours

Reference(s)

1. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Third Edition, CBS Publishers & Distributors-New Delhi, 2002.
2. A. Chakraverty, A.S. Mujumdar, G.S.Vijaya Raghavan and H.S. Ramaswamy, Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices. CRC Press, USA, 2003.
3. Girdhari Lal, G. S.Siddappa and G.L. Tandon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 2009.
4. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.
5. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.

22FD040 BEVERAGE TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the classification of beverages
- Impart knowledge and skills of beverage processing techniques
- Understand the quality aspects of beverages

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

e. Modern Tool Usage: Create, select and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

f. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

n. Practical and research training imparted to the students will pave the way for introducing novel technologies in food processing sectors for global sustenance.

Course Outcomes (COs)

1. Organize the formulation of beverages using selected ingredients
2. Apply Unit operations involved in the carbonated beverage manufacturing
3. Explain the various production techniques in non-carbonated beverages
4. Evaluate the quality parameters of fermented beverages
5. Implement the food laws and regulations of beverages

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2	2	2	2							1	2
2	1		3	1	2	1							2	3
3	2		2	2	2	2							1	2
4	3		2	1	1	2							2	1
5	2		2	2	2	2							1	2

UNIT I **10 Hours**

INGREDIENTS IN BEVERAGES

Beverage: Introduction, Global and Indian scenario. Classification of beverages. Ingredients- water, quality evaluation, raw and processed water, bulk and intense sweeteners, water miscible and water dispersible flavouring agents, Micro and nano-emulsions of flavors, colours- natural and artificial, preservatives, clouding agents, emulsifiers and stabilizers.

UNIT II **9 Hours**

CARBONATED BEVERAGES

Preparation of Syrup making, blending, Carbonation of soft drinks, filling, packaging, containers, closures. Powdered dry mix; Energy drinks and sports drinks; Fruit based carbonated beverages, carbonated water. Equipment used in the manufacture of carbonated beverages.

UNIT III **10 Hours**

NON-CARBONATED BEVERAGES AND BOTTLED WATER

Beverages based on tea, coffee, cocoa, spices, herbs, dairy based beverages, Fruit based non carbonated beverage - RTS beverages, Squash, Nectar, Cordial and Fruit concentrate. Flash pasteurization, Canning and Aseptic Packaging of beverages. Bottled water, mineral water, spring water, flavored water.

UNIT IV **9 Hours**

FERMENTED BEVERAGES

Alcoholic beverages- Classification. Fermented alcoholic beverage - Beer - ale type beer, lager type beer, the role of yeast in beer, technology of brewing process. Wine, Cider, Perry and Sake. Distilled spirits - Whisky, Brandy, Vodka, Rum, Tequila and gin. Equipment used for brewing and distillation.

UNIT V **7 Hours**

SANITATION AND QUALITY CONTROL

Quality control in beverage industry- System quality control Product quality control and microbial quality control. CIP. Sanitation and hygiene in beverage industry. Standards and regulations of beverages.

Total: 45 Hours

Reference(s)

1. L.Jagan Mohan Rao and K.Ramalakshmi, Recent trend in Soft beverages, Woodhead Publishing India Pvt Ltd.,New Delhi 2011
2. Woodroof, Jasper Guy, and G. Frank Phillips. Beverages: carbonated and noncarbonated. AVI Pub. Co., 1981
3. Mitchell, Alan J. Formulation and Production Carbonated Soft Drinks. Springer Science & Business Media, 1990
4. Richard Coles and Mark Kirwan Food and Beverage Packaging Technology Second Edition Blackwell Publishing Ltd., 2011.
5. Hui, Yiu H., et al., eds. Handbook of food and beverage fermentation technology. Vol. 134. CRC Press, 2004.
6. Boulton, Christopher, and David Quain. Brewing yeast and fermentation. John Wiley & Sons, 2008.

22FD041 VALUE ADDED PRODUCTS FROM FRUITS AND VEGETABLES

3 0 0 3

Course Objectives

- Understand Fruits and Vegetable Processing Techniques and its quality grading
- Analyze the methods of processing for value added products from fruits and vegetables
- Evaluate the packaging requirement and quality control of value added products

Programme Outcomes (POs)

a. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

b. Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

c. Design/ Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

d. Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

m. Students will be able to conduct innovative and high quality research to solve emerging problems in food technology by applying scientific knowledge

Course Outcomes (COs)

1. Understand the trend and selection of raw materials in value added products.
2. Assess the techniques involved in fruit and vegetable processing
3. Analyze the quality and manufacturing techniques of fruit products
4. Outline the quality and manufacturing techniques of vegetable products
5. Evaluate the extraction of flavour components from minor spices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2	2									2	
2	2	2	2	2									2	
3	2	3	2	2									2	
4	3	2	2	2									2	
5	3	2	3	3									3	

UNIT I **9 Hours**

INTRODUCTION TO VALUE-ADDED PRODUCTS

Overview of Value-Added Processing - Definition and significance of value-added products - Market trends and consumer demand for processed fruits and vegetables - Selection of raw materials - importance of quality and ripeness of fruits and vegetables - Heat treatment

UNIT II **9 Hours**

PROCESSING TECHNIQUES

Canning - Introduction and Method; Drying techniques of fruits and vegetables - benefits and challenges; Freezing methods -benefits and challenges; Packaging consideration of frozen fruits and vegetables

UNIT III **9 Hours**

VALUE ADDED PRODUCTS FROM FRUITS

Value added products of mango - pulp, juice, concentrates, toffee, kernel flour; value added products of pineapple - canned pineapple, jam, vinegar, toffee; Value added products of grapes - wine, jelly, raisins.

UNIT IV **9 Hours**

VALUE ADDED PRODUCTS FROM VEGETABLES

Value added products of tomato - puree, paste, powder, sauce; Value added products from tuber crops - cassava flour, sago, starch; Value added products of curcurbits - pumpkin seeds, cucumber pickles, bottle gourd tuty fruit, ash gourd petha. Minimally processed products and vegetable powders, plant based foods.

UNIT V **9 Hours**

PACKAGING AND QUALITY CONTROL OF VALUE ADDED PRODUCTS

Packaging and storage of value added fruits and vegetables; Quality analyses and FSSAI specifications of fruits and vegetable products. Market value; Waste Reduction

Total: 45 Hours

Reference(s)

1. Chakraverty, A, Arun S. Mujumdar, G.S.Vijayaraghavan, and Hosahalli. S. Ramaswamy. Handbook of Post Harvet Technology: Cereals, Fruits, Vegetables, Tea and Spices, Marcel Dekker. Inc. New York.2003
2. K.Sharma, Stevan J.Mulvaney and Syed S.H. Rizvi, Food Process Engineering-Theory and Laboratory equipments, John Wiley & Sons, New York, 2000.
3. Norman W. Desrosier, and James N. Desrosier. The Technology of Food Preservation 4th Edition, CBS Publisher & Distributions, New Delhi, 2004.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

Course Outcomes (COs)

1. Apply thee bio resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio- refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1		2				3								1
2	2						1								3
3	1						3								2
4	2						3								3
5	1						1								

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative and thermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purification of glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology, McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer, 2007

22OPH01 NANOMATERIALS SCIENCE **3 0 0 3**

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	1												
2	2	2												
3	3	1												
4	1	1												
5	2	3												

9 Hours

UNIT I

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future -classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

9 Hours

UNIT II

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes-structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	1												
4	2	1												
5	2	1												

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

9 Hours

UNIT V

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

22OPH03 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	1												
4	2	1												
5	1	2												

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement - holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006

22OPH04 BIO-PHOTONICS 3 0 0 3

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

UNIT I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIO-NANO-PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G.Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R.Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy : Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

22OPH05 PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supramolecules
- To summarize the soft matter proprties of structures and components of life

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2	1												
3	2	2												
4	2	2												
5	2	2												

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS & GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids.Physical and chemical gels-classical theory of gelation-elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

REFERENCES

1. Richard A L Jones, *Soft Condensd Matter*, Oxford University Press, UK, 2002
2. Masao Doi, *Soft Matter Physics*,Oxford University Press, UK, 2013.
3. Ian W. Hamley, *Introduction to Soft Matter*, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, *Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics*, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, *Soft Matter Physics: An Introduction*, Springer-Verlag, New York, 2003.

22OCH01 CORROSION SCIENCE AND ENGINEERING

3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	2						1							
3	1	3												
4	2	2												
5	3	3					1							

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html

22OCH02 POLYMER SCIENCE 3 0 0 3

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1												
2	1	2												
3	2	2												
4	1	1	2											
5	1	3	2											

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

22OCH03 ENERGY STORING DEVICES 3 0 0 3

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	1												
2	2	3					1							
3	3	1												
4	2	2					1							
5	3	3					1							

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium,and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery. Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

22OMA01 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

- Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	1	2													
2	1	3													
3	2	3													
4	2	3													
5	3	3													

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									2		2				

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

FURTHER READING

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005.
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.

22OGE02 ENTREPRENEURSHIP DEVELOPMENT I 3 0 0 3

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	2		2						

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment,Segmentation, Targeting and positioning, Formulating marketing strategies,Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, Factories Act 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional tax (Cases).Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill: 2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html