DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)

PERAMBALUR - 621212

REGULATIONS – 2023

CHOICE BASED CREDIT SYSTEM

B.Tech FOOD TECHNOLOGY

CURRICULUM & SYLLABI

DEPARTMENT OF FOOD TECHNOLOGY

(Applicable to students admitted from the Academic year 2023 – 2024 and subsequently under Choice Based Credit System)

Discussed in BOS-4 meeting Dated: 12.09.2024 / Food Technology Ratified & Approved in Academic Council

VISION MISSION OF THE INSTITUTION

Vision:

An active and committed centre of advanced learning focused on research and training in the fields of Engineering, Technology and Management to serve the nation better.

Mission:

- To develop eminent scholar with a lifelong follow up of global standards by offering UG,PG and Doctoral Programmes.
- To pursue Professional and Career growth by collaborating mutually beneficial partnership with industries and higher institutes of research.
- To promote sustained research and training with emphasis on human values and leadership qualities.
- To contribute solutions for the need based issues of our society by proper ways and means as dutiful citizen.

DEPARTMENT OF FOOD TECHNOLOGY

About the Department

The Department of Food Technology was established in 2018, affiliation of Anna University with B.Tech Program in Food Technology. Later the department has become autonomous institution in 2020 with a mission to provide excellence in education, to make students entrepreneur and employable and continuous upgradation of techniques for reaching heights. About 100+ students successfully completed UG Programme with good performance. The students were placed in reputed organizations in different regions across the globe. The department has total strength of 10 including teaching and non- teaching staffs. Among them, 4 faculty members hold doctorates, with specialization in food microbiology, nanotechnology, food chemistry and food processing. A bunch of well qualified and experienced professor and assistant professor guide the department aiming at educating and training the students with sound knowledge and awareness in latest field of technology and development.

Vision:

Prepare the food engineers to pursue their goals and to have successful career as competent technologist, scientist, researchers, entrepreneurs and personalities which benefits the public welfare through rigorous service in their challenging field.

Mission:

M1: Upgrade the scientific knowledge with a lifelong follow up in the areas of food science, food processing and safety for the development of food products through quality research.

M2: Extend to know how to identify and analyse the opportunities in Food Technologto adopt strategies that ensure socio-economic growth by collaborating with industries.

M3: Providing research and professional services to streamline and optimize operations which contribute to the enhancement of the quality of life.

M4: Develop socially responsible professionals and entrepreneurs who are capable of sustainable engineering practices for food industry.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO 1	Student will be able to pursue higher education in India or abroad in the field of Food Technology and it's related field and take up the competitive exams
PEO 2	Student will be able to come up with solutions for any technical and scientific problems related to Food Technology in institution, industry and society
PEO 3	Student will get familiarised in job related skills like communication, designing of experiments and entrepreneur skills in the field of food technology

PROGRAM OUTCOMES (POs)

PO	Graduate Attribute
PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**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.
PO3	**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.
PO4	**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.
PO5	**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.
PO6	**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.
PO7	**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.
PO8	**Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.

PO11	**Project management and finance:** 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.
PO12	**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.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO 1	Apply basic skills and knowledge in Engineering to develop innovative food processing techniques and food products.
PSO 2	Adapt multidisciplinary approaches to solve food industry problems and ensure food quality and safety
PSO 3	Develop critical thinking and problem-solving skills in the domain of food technology with professional integrity and ethical values

PEO's – PO's & PSO's MAPPING:

PEO	**PO**												**PSO**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
I.	**3**		**2**		**3**						**2**	**3**	**3**		**2**
II.		**3**		**3**		**2**		**3**						**3**	
III.		**2**	**2**				**3**		**3**	**2**		**3**	**3**		**3**

DHANALAKSHMI SRINIVASAN ENGINEERING COLLEGE (AUTONOMOUS)

PERAMBALUR – 621 212.

B.TECH. FOOD TECHNOLOGY

REGULATIONS 2023 (UPDATED ON SEPTEMBER 2024)

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI FOR SEMESTERS I TO VIII

SEMESTER – I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	IP3151	Induction Programme		-	-	-		0
2	U23HST11	Communicative English	HSMC	3	0	0	3	3
3	U23MAT12	Matrices and Calculus	BSC	3	1	0	4	4
4	U23CYT14	Chemistry for Engineering and Technology	BSC	3	0	0	3	3
5	U23PHT13	Physics for Engineers and Technologists	BSC	3	0	0	3	3
6	U23GET16	Engineering Graphics	ESC	3	1	0	4	4
7	GE3152	தமிழர் மரபு /Heritage of Tamils	HSMC	1	0	0	1	1
PRACTICALS								
8	U23HSP12	English Laboratory	HSMC	0	0	2	2	1
9	U23BSP11	Physics and Chemistry Laboratory	BSC	0	0	4	4	2
10	U23GEP14	Engineering Practices Laboratory	ESC	0	0	4	4	2
TOTAL				**16**	**2**	**10**	**28**	**23**

SEMESTER- II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23MAT22	Statistics and Numerical methods	BSC	3	1	0	4	4
2	U23HST21	Professional English	HSMC	3	0	0	3	2
3	U23PHT26	Physics of Materials	BSC	3	0	0	3	3
4	U23GET15	Problem Solving and Python Programming	ESC	3	0	0	3	3
5	U23EET25	Basic Electrical, Electronics and Instrumentation Engineering	ESC	3	0	0	3	3
6		NCC credit course Level 1		2	0	0	2	2*
7	GE3252	தமிழரும் தொழில் நுட்பமும் /Tamils and Technology	HSMC	1	0	0	1	1
PRACTICALS								
8	U23EEP24	Basic Electrical, Electronics and Instrumentation Engineering Laboratory	ESC	0	0	4	4	2
9	U23HSP22	Communication Laboratory	EEC	0	0	4	4	2
10	U23GEP13	Problem Solving and Python Programming Laboratory	ESC	0	0	4	4	2
TOTAL				**16**	**1**	**12**	**29**	**22**

SEMESTER- III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23MAT31	Transforms and Partial Differential Equations	BSC	3	1	0	4	4
2	U23FTT31	Food Process Calculations	PCC	3	0	0	3	3
3	U23FTT32	Biochemistry and Nutrition	PCC	3	0	0	3	3
4	U23FTT33	Unit operations in food processing	PCC	3	0	0	3	3
5	U23FTT34	Post-Harvest Engineering	PCC	3	0	0	3	3
6	U23GET41	Environmental Sciences and Engineering	HSMC	3	0	0	3	2
PRACTICALS								
7	U23FTP31	Biochemistry and Nutrition Laboratory	PCC	0	0	4	4	2
8	U23FTP32	Unit operations in food processing Laboratory	PCC	0	0	4	4	2
TOTAL				**18**	**1**	**8**	**27**	**22**

SEMESTER – IV

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23MAT42	Probability And Operations Research	BSC	3	1	0	4	4
2	U23FTT41	Food Chemistry and Preservation.	PCC	3	0	0	3	3
3	U23FTT42	Food Microbiology	PCC	3	0	0	3	3
4	U23FTT43	Properties of food materials	PCC	3	0	0	3	3
5	U23FTT35	Thermodynamics in food industries	PCC	3	0	0	3	3
6	U23GET61	Human Values and Ethics	HSMC	3	0	0	3	2
PRACTICALS								
8	U23FTP41	Food Chemistry and Preservation Laboratory	PCC	0	0	4	4	2
9	U23FTP42	Food Microbiology Laboratory	PCC	0	0	4	4	2
10	U23HSP41	Communication Skills	EEC	0	2	2	4	2
TOTAL				**18**	**2**	**10**	**30**	**24**

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TPOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23FTT51	Food Analysis	PCC	3	0	0	3	3
2	U23FTT52	Heat and Mass transfer in Food Processes	PCC	3	1	0	4	4
3		Professional Elective I	PEC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
5		Professional Elective III	PEC	3	0	0	3	3
6		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
7	U23FTP51	Food Analysis Laboratory	PCC	0	0	4	4	2
8	U23FTP52	Heat and Mass transfer in food processes Laboratory	PCC	0	0	4	4	2
9	U23FTP53	Workshop / Industrial Training	EEC	0	0	0	-	1
TOTAL				**21**	**0**	**8**	**29**	**24**

*Two weeks workshop industrial training/internship during IV Semester Summer Vacation will be evaluated in V semester.

SEMESTER – VI

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23FTT61	Refrigeration and Cold Chain Management	PCC	3	0	0	3	3
2	U23FTT62	Food Process Engineering	PCC	3	0	0	3	3
3	U23FTT63	Entrepreneur and Start ups in Food Sectors	EEC	3	0	0	3	2
4		Professional Elective IV	PEC	3	0	0	3	3
5		Professional Elective V	PEC	3	0	0	3	3
6		Elective Management	HSMC	3	0	0	3	3
7		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
7	U23FTP61	Food Process Engineering Laboratory	PCC	0	0	4	4	1.5
8	U23FTP62	Baking and Confectionery laboratory	PCC	0	0	4	4	1.5
9	U23FTP63	Village Adoption **	MCC	0	1	1	2	1
10	U23FTP64	Industrial Training/Internship – I*	EEC	0	0	0	0	0
TOTAL				**21**	**1**	**9**	**29**	**23**

*Two weeks Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester.

SEMESTER – VII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23FTT71	Food plant layout and Economics	PCC	3	0	0	3	3
2	U23FTT72	Dairy Technology	PCC	3	0	0	3	3
3		Professional Elective VI	PEC	3	0	0	3	3
4		Open Elective	OEC	3	0	0	3	3
5		Open Elective	OEC	3	0	0	3	3
7	U23FTP71	Dairy Technology Laboratory	PCC	0	0	4	4	2
8	U23FTP72	Mini-project	PCC	0	0	4	4	2
9	U23FTP73	Industrial Training/Internship – II	EEC	0	0	-	-	1
TOTAL				**15**	**0**	**8**	**23**	**20**

*****Two weeks Industrial training/Internship during VI Semester Summer Vacation will be evaluated in VII semester.

SEMESTER – VIII

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23FTP81	Project work	PCC	0	0	20	20	10
TOTAL				**0**	**0**	**20**	**20**	**10**

MANAGEMENT ELECTIVE

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23GET71	Principles of Management	HSMC	3	0	0	3	3
2.	U23GET72	Total Quality Management	HSMC	3	0	0	3	3
3.	U23GET73	Engineering Economics and Financial Accounting	HSMC	3	0	0	3	3
4.	U23GET74	Human Resource Management	HSMC	3	0	0	3	3
5.	U23GET75	Knowledge Management	HSMC	3	0	0	3	3
6.	U23GET76	Industrial Management	HSMC	3	0	0	3	3

VERTICAL I: FOOD PROCESSING TECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23FTV11	Fruits and Vegetables Processing Technology	PEC	3	0	0	3	3
2.	U23FTV12	Baking and Confectionery Technology	PEC	3	0	0	3	3
3.	U23FTV13	Plantation and Spices Technology	PEC	3	0	0	3	3
4.	U23FTV14	Technology of Cereals, Pulses and Oil Seeds	PEC	3	0	0	3	3
5.	U23FTV15	Meat, Fish and Poultry Processing	PEC	3	0	0	3	3
6.	U23FTV16	Food Packaging Technology	PEC	3	0	0	3	3

VERTICAL II: FOOD ANALYSIS AND FOOD SAFETY

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23FTV21	Introduction to Food analysis	PEC	3	0	0	3	3
2.	U23FTV22	Instrumental Techniques for Food Analysis	PEC	3	0	0	3	3
3.	U23FTV23	Sensory Evaluation of Foods	PEC	3	0	0	3	3
4.	U23FTV24	Principles Of Food Safety	PEC	3	0	0	3	3
5.	U23FTV25	Food Safety and Quality Control	PEC	3	0	0	3	3
6.	U23FTV26	Food laws- Indian and International	PEC	3	0	0	3	3

VERTICAL III: NEXT GENERATION TECHNOLOGIES IN FOOD INDUSTRIES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23FTV31	High performance computing	PEC	3	0	0	3	3
2.	U23FTV32	Food materials science	PEC	3	0	0	3	3
3.	U23FTV33	Food structuring techniques	PEC	3	0	0	3	3
4.	U23FTV34	Concepts on Experimental design and modelling	PEC	3	0	0	3	3
5.	U23FTV35	Statistical tool in data analysis	PEC	3	0	0	3	3
6.	U23FTV36	Internet of things in Food and Agriculture	PEC	3	0	0	3	3

VERTICAL IV: FOOD BIOTECHNOLOGY

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1.	U23FTV41	Introduction to Food Biotechnology	PEC	3	0	0	3	3
2.	U23FTV42	Enzymes in Food and feed industry	PEC	3	0	0	3	3
3.	U23FTV43	Food fermentation technology	PEC	3	0	0	3	3
4.	U23FTV44	Biological instrumentation and Process control	PEC	3	0	0	3	3
5.	U23FTV45	Food allergens and toxicology	PEC	3	0	0	3	3
6.	U23FTV46	Genetic engineering and Genetically modified foods	PEC	3	0	0	3	3

	Vertical 1 Food Processing Technology	**Vertical 2 Food analysis and Food safety**	**Vertical 3 Next Generation Technologies in food industries**	**Vertical 4 Food Biotechnology**
Professional Elective I	Fruits and Vegetables Processing Technology	Analysis of food products	High performance computing	Introduction to Food Biotechnology
Professional Elective II	Baking and Confectionery Technology	Instrumental Techniques for Food Analysis	Food materials science	Enzymes in Food and feed industry
Professional Elective III	Plantation and Spices Technology	Sensory Evaluation of Foods	Food structuring techniques	Food fermentation technology
Professional Elective IV	Technology of Cereals, Pulses and Oil Seeds	Principles of Food Safety	Concepts on experimental design and modelling	Biological instrumentation and Process control
Professional Elective V	Meat, Fish and Poultry Processing	Food Safety and Quality Control	Statistical tool in data analysis	Food allergens and toxicology
Professional Elective VI	Food Packaging Technology	Food laws- Indian and International	Internet of things in Food and Agriculture	Genetic engineering and Genetically modified foods

OPEN ELECTIVES

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1	U23FTO11	Transport Phenomena in Food Processing	OEC	3	0	0	3	3
2	U23FTO12	Food Quality and Safety Engineering	OEC	3	0	0	3	3
3	U23FTO13	Storage Engineering and Handling of Agricultural Products	OEC	3	0	0	3	3
4	U23FTO14	Fundamentals of Food Processing	OEC	3	0	0	3	3
5	U23FTO15	Agri Business Management and Retail marketing	OEC	3	0	0	3	3
6	U23FTO22	Nutraceuticals	OEC	3	0	0	3	3
7	U23FTO23	Innovative Packaging of Dairy Products	OEC	3	0	0	3	3
8	U23FTO24	Technology of Food Colors and Flavors	OEC	3	0	0	3	3
9	U23FTO31	Nano Technology in Food Systems	OEC	3	0	0	3	3
10	U23FTO33	Traditional Food	OEC	3	0	0	3	3
11	U23FTO34	Nutrition and Healthy Life	OEC	3	0	0	3	3
12	U23FTO35	Food Informatics	OEC	3	0	0	3	3
13	U23FTV23	Sensory Evaluation of Foods	OEC	3	0	0	3	3
16	U23FTV24	Principles of Food Safety	OEC	3	0	0	3	3
14	U23FTV32	Food materials science	OEC	3	0	0	3	3
15	U23FTV36	Internet of things in Food and Agriculture	OEC	3	0	0	3	3

SUMMARY OF CREDITS

B. TECH FOOD TECHNOLOGY										
S. No	Subject Area	Credits Per Semester								Total Credits	Percentage (%)
		I	II	III	IV	V	VI	VII	VIII		
1	**HSMC**	5	3	2	2	-	3	-	-	15	8.93
2	**BSC**	12	7	4	4	-	-	-	-	27	16.07
3	**ESC**	6	10	-	-	-	-	-	-	16	9.52
4	**PCC**	-	-	16	16	11	9	10	10	72	42.86
5	**PEC**	-	-	-	-	9	6	3	-	18	10.71
6	**OEC**	-	-	-	-	3	3	6	-	12	7.14
7	**EEC**	-	2	-	2	1	2	1	-	8	4.76
Total		**23**	**22**	**22**	**24**	**24**	**23**	**20**	**10**	**168**	100

SEMESTER – I

IP3151 INDUCTION PROGRAMME

This is a mandatory 2 weeks program to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction program has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

Hence, the purpose of this program is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Program. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG program.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering / Technology / Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Program is totally an activity based program and therefore there shall be no tests / assessments during this program.

REFERENCES : Guide to Induction program from AICTE

U23HST11	COMMUNICATIVE ENGLISH	L	T	P	C
		3	0	0	3

(COMMON TO ALL B.E./ B.TECH. PROGRAMMES)

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To enhance students listening ability for academic and Professional purposes
2. To learn to use basic grammatical structures in suitable contexts
3. To help students acquire the ability to speak effectively in English in real - life situations
4. To help learners use language effectively in professional contexts.
5. To develop students' ability to read and write complex texts, summaries, articles, definitions, Paragraph user manuals.

UNIT I INTRODUCTION TO EFFECTIVE COMMUNICATION 9

Define communication. Kinds of communication. Quintessential of communication in technical progression. Key characteristics of an effective communicator- listening, attitude modification, way of response with appropriate language, tone modulation. **Listening**- Listening to TV news, Guest lectures. Speaking- Answering the Questions. **Reading** - Reading brochures and technical magazines (technical context), telephone messages / social media messages relevant to technical contexts and emails, **Writing**-Reading comprehension, Parts of Speech.

UNIT II READING QUEST 9

Listening- listening and responding to video lectures/talks. **Speaking**- Day today conversations. **Reading** –Edison of India-GD Naidu "The Great Inventor". **Writing-** Emails / Informal Letters - Inviting, Congratulating & Thanking, Punctuations

UNIT III LANGUAGE RESOURCE GROWS CRITICAL JUDGEMENT 9

Listening- listening to specific task-focused audio tracks. Speaking- summary of Robert Frost "Stopping by woods on a snowy evening". Reading – Reading advertisements, gadget reviews; user manuals. Writing – Essay Writing: Analytical essay: Narrative Essay, Developing Hints, Usage of tenses in sentence formation. Voices

UNIT IV LANGUAGE IN LIFE SKILL 9

Listening- Listening to speech of Great Scholars. Speaking- mechanics of presentation. **Reading** – Newspaper articles, power point presentation. **Writing** – Checklist, Jumbled sentences-Rearrange the sentences in correct order, WH-Questions-Form questions by using statements, Prefixes and Suffixes

UNIT V IMPROVING SPEAKING &READING 9

Listening- listening to situational based dialogues; Speaking- Stating intention to do something-Expressing opinion-asking people to repeat themselves. Reading – Summary of O.Henry's "The last Leaf". Writing – Dialogue Writing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1: Remember appropriate words in a situational conversation.

CO2: Gain understanding of basic grammatical structures and use them in right context.

CO3: Read and infer the denotative and connotative meanings of technical texts.

CO4: Write Dialogue, Letter and paragraphs on various topics.

CO5: Make the students prepare effective notes for main sources available.

CO6: Enhance them to give operational talk.

TEXT BOOKS:

1. English for Engineers & Technologists Orient Blackswan Private Ltd. Department of English, Anna University, (2020 edition).
2. English for Science & Technology Cambridge University Press, 2021. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.
3. The Gift of the Magi by O.Henry, McClure,Philips and company.

REFERENCE BOOKS:

1. Technical Communication – Principles and Practices by Meenakshi Raman & Sangeeta Sharma, Oxford Univ. Press, 2016, New Delhi.
2. A Course Book on Technical English by Lakshminarayanan, Scitech Publications (India) Pvt. Ltd.
3. English For Technical Communication (With CD) By Aysha Viswamohan, Mcgraw Hill Education.

U23MAT12	MATRICES AND CALCULUS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
2. To familiarize the students with differential calculus.
3. To familiarize the student with functions of several variables
4. To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.
5. To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems

UNIT I MATRICES **12**

Introduction – Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of Eigenvalues and Eigenvectors – Cayley Hamilton theorem – Diagonalization of the matrices by Orthogonal Transformations – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms.

UNIT II DIFFERENTIAL CALCULUS **12**

Limit of a function – Continuity – Derivatives – Differentiation rules – Implicit differentiation – Logarithmic differentiation – Maxima and Minima of functions of one variable.

UNIT III MULTIVARIABLE CALCULUS **12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Jacobians – Taylor's series for functions of two variables – Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV MULTIPLE INTEGRAL AND THEIR APPLICATIONS **12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals.

UNIT V ORDINARY DIFFERENTIAL EQUATIONS **12**

Higher order linear differential equations with constant coefficients– Method of variation of parameters – Homogenous equation of Euler's and Legendre's type – System of simultaneous linear differential equations with constant coefficients – Method of undetermined coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Use the matrix algebra methods for solving practical problems.
CO2: Use both the limit definition and rules of differentiation to differentiate functions.
CO3: Apply differential calculus tools in solving various application problems.
CO4: Able to use differential calculus ideas on several variable functions.
CO5: Apply multiple integral ideas in solving areas, volumes and other practical problems.

CO6: Solve the ordinary differential equations using different techniques for that model engineering problems.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", John Wiley and Sons, 10th Edition, New Delhi, 2016.
2. Grewal. B.S., "Higher Engineering Mathematics",Khanna Publishers, New Delhi, 44th Edition, 2018.
3. James Stewart, "Calculus: Early Transcendentals", Cengage Learning, 8th Edition, New Delhi, 2015. [For Units II & IV - Sections 1.1, 2.2, 2.3, 2.5, 2.7 (Tangents problems only), 2.8, 3.1 to 3.6, 3.11, 4.1, 4.3, 5.1 (Area problems only), 5.2, 5.3, 5.4 (excluding net change theorem), 5.5, 7.1 - 7.4 and 7.8].

REFERENCE BOOKS:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", Firewall Media (An imprint of Lakshmi Publications Pvt.,Ltd.,), New Delhi, 7th Edition, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", Narosa Publications, NewDelhi, 5th Edition,2016.
3. Narayanan. S. and Manicavachagom Pillai. T. K.,"Calculus" Volume I and II, S.Viswanathan Publishers Pvt. Ltd., Chennai, 2009.
4. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt.Ltd, New Delhi, 2016
5. Thomas. G. B., Hass. J, and Weir. M.D,"Thomas Calculus", 14th Edition, Pearson India, 2018.

U23CYT14	CHEMISTRY FOR ENGINEERING & TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To inculcate sound understanding of water quality parameters and water treatment techniques.
2. Impart knowledge on the basic principles and preparatory methods of nanomaterial.
3. To introduce the basic concepts and applications of phase rule and composites.
4. To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
5. To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I WATER TREATMENT **9**

Water: Sources , impurities, Parameters. Types of water Hardness of water -types – expression of hardness – units – Estimation of hardness of water by EDTA. Desalination - Reverse Osmosis. Boiler troubles: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralisation and zeolite process.

UNIT II ELECTRO AND NANO CHEMISTRY **9**

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf by Poggendorff's compensation principle. Single electrode potential – Nernst equation – reference electrodes -types–Calomel electrode - electrolysis of water. Nanomaterials: Basics of Nano Chemistry: Distinction between molecules, nanomaterials and bulk materials. Preparation of nanomaterials- laser ablation method and Chemical Vapour Deposition (CVD). Application of Nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III PHASE RULE AND COMPOSITES **9**

Phase rule terms with examples. water system; Reduced phase rule Two component system: lead-silver system – Composites, Need, Constitution: Matrix materials, Applications and Reinforcement and applications of Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. Hybrid composites - definition and examples.

UNIT IV FUELS & COMBUSTION **9**

Fuels –Classification-Coal and coke: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). Petroleum and Diesel: Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; Power alcohol and biodiesel. Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; Ignition temperature: spontaneous ignition temperature, Explosive range; Flue gas analysis - ORSAT Method. CO_2 emission and carbon foot print.

UNIT V ENERGY SOURCES AND STORAGE DEVICES **9**

Nuclear energy: light water nuclear power plant, breeder reactor. Solar energy conversion: Principle, working and applications of solar cells; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries: Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion- battery; Electric vehicles-working principles; Fuel cells: H_2-O_2 fuel cell, microbial fuel cell; Supercapacitors: Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.

CO2: Apply the basic knowledge of Corrosion and various electrodes.

CO3: Know the economically and new methods of synthesis nano materials.

CO4: Apply the knowledge of phase rule and composites for material selection requirements.

CO5: Understand the concepts of suitable fuels for engineering processes and applications.

CO6: Have the knowledge of different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", S. Chand Publishing, 12th Edition, 2018.
4. J.Manivel , "Engineering Chemistry" R.K.Publishers, 1st Edition 2022.

REFERENCE BOOKS:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" McGraw Hill Education (India) Private Limited, 2nd Edition, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, "Engineering Chemistry-Fundamentals and Applications", Cambridge University Press, Delhi, Second Edition, 2019.

U23PHT13	PHYSICS FOR ENGINEERS AND TECHNOLOGISTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To make the students to gain the knowledge in elastics and plastic nature of the materials in the presence and absence of load.
2. To understand the students to know the application of the sound waves in different fields.
3. To motivate the students towards the applications of photo electric phenomena.
4. To know the physical principle of LASER, the working of LASER applications.
5. To understand the propagation of light in optical fibers and its applications.

UNIT I ELASTICITY **9**

Introduction- Elasticity - plasticity– Hooke's law - relationship between three Module of elasticity (Qualitative) – stress & strain diagram and its uses -Poisson's ratio - factors affecting elasticity - twisting couple of wire - Torsion Pendulum: theory and experiment. Beam: Internal bending moment – Cantilever: theory and experiment – Young's Modulus: uniform and non – uniform bending (Qualitative) – I-shaped girders- advantages and applications.

UNIT II ULTRASONICS **9**

Introduction – classification of sound- properties of infrasonic, audible and ultrasonics - production: Magnetostriction and Piezoelectric methods – determination of velocity of sound in liquid (Acoustic Grating Method) – general applications – industrial application: Non - Destructive Testing: pulse echo system through transmission and reflection modes. ultrasonic scanning methods – medical application: sonogram.

UNIT III MODERN PHYSICS **9**

Introduction –Black Body Radiation – Classical and Quantum Laws of Black Body Radiation - Photon and its Properties - Wave Particle Duality and Matter waves – De - Broglie Wavelength - Schrodinger's Time Independent and Time Dependent Wave Equations - Physical Significance of The Wave Function. Application: Particle in One Dimensional Box - Normalization Process – Photo Electric Effect – Laws Governing the Photoelectric Effect – Einstein's Formula - Derivation – Applications: Solar Cell – Solar Water Heater – Photo resistor (LDR).

UNIT IV LASERS **9**

Lasers: Introduction - Properties of Laser-Spontaneous and Stimulated Emission Process - Einstein's Theory of Matter Radiation Interaction & A and B Coefficients; Amplification of Light by Population Inversion – Pumping Methods - Types of Lasers: Solid-State Laser (Homo and Hetero Junction Semiconductor Lasers), Gas Laser (CO_2), Applications: Laser Cutting and Welding, LIDAR and Barcode Scanner.

UNIT V FIBER OPTICS AND APPLICATIONS **9**

Optical Fiber: Structure - advantages- Principle [TIR]–Propagation Phenomena in optical fiber - Expression for Acceptance Angle and Numerical Aperture – Relation between Refractive Index of Core, Numerical Aperture and Fractional Index Change – Fabrication: Double Crucible Method - Types: Material, Mode, Refractive Index - Applications: Optical Fiber Communication System – fiber optic sensors (Displacement and pressure sensors) – Medical Endoscope.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Differentiate the elastic and plastic nature of the materials.

CO2: Know the experimental techniques in both production and applications of ultrasonic waves.

CO3: Gain knowledge in the basics of quantum mechanics concepts.

CO4: Develop new devices based on LASER source.

CO5: Understand the advantages of optical fiber than metal wire.

CO6: Demonstrate some useful experiments based on optical fibre

TEXT BOOKS:

1. Dr. P.Mani, "Engineering Physics", Dhanam Publications, 2013.
2. Dr. G. Senthilkumar, "Engineering Physics", VRB Publishers, 2017.
3. K. Thyagarajan, Ajoy Ghatak, "Lasers Fundamentals and Applications" IInd Edition, Springer, 2010.
4. D.K. Bhattacharya, Poonam Tandon," Engineering Physics", Oxford HED Publishers, 2017.

REFERENCE BOOKS:

1. Marikani, "Engineering Physics", PHI, New Delhi, 2013.
2. Bhattacharya & Bhaskaran, "Engineering Physics", Oxford Publications, 2012.
3. R Murugeshan, Kiruthiga, Sivaprasath S, "Modern Physics", Chand Publishing, 2021.
4. S. Rajivgandhi & A. Ravikumar, "Engineering Physics I", RK Publications, 2023
5. Sathyaprakash, "Quantum Mechanics", Pragati Prakashan, Meerut, 2016.

U23GET16	ENGINEERING GRAPHICS	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop in students, graphic skills for communication of concepts, ideas and design of engineering products.
2. To expose them to existing national standards related to technical drawings.
3. Develop proficiency in 2D drafting using drawing tools.
4. Learn sectional views and assembly drawing techniques.
5. Enhance visualization skills for improved problem-solving and communication in engineering.

UNIT I PLANE CURVES AND ORTHOGRAPHIC PROJECTION 6+12

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimension. Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves. Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

UNIT II PROJECTION OF POINTS, LINES AND PLANE SURFACE 6+12

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method (polygonal and circular surfaces) inclined to both the planes.

UNIT III PROJECTION OF SOLIDS 6+12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 6+12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple solids – Prisms, pyramids cylinders and cones.

UNIT V ISOMETRIC PROJECTION 6+12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions-Perspective Projection.

TOTAL: 30+40=90 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Identify the significance of graphics in engineering applications.

CO2: Project straight lines inclined to both principal planes and determine true lengths and inclinations.

CO3: Apply orthographic projection techniques to project solids.

CO4: Apply the principles of development to prisms, pyramids, cylinders, and cones.

CO5: Combine two solid objects in simple vertical positions using isometric projection.

CO6: Utilize the isometric scale effectively.

TEXT BOOKS:

1. Natrajan K.V., ―A text book of Engineering Graphics‖, Dhanalakshmi Publishers, Chennai,2009
2. Venugopal K. and Prabhu Raja V., ―Engineering Graphics‖, New Age International (P) Limited, 2008

REFERENCE BOOKS:

1. Bhatt N.D. and Panchal V.M., ―Engineering Drawing‖, Charotar Publishing House, 50th Edition, 2010.
2. Basant Agarwal and Agarwal C.M., ―Engineering Drawing‖, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
3. Gopalakrishna K.R., ―Engineering Drawing‖ (Vol. I & amp; II combined), Subhas Stores, Bangalore, 2007.
4. Luzzader, Warren.J. and Duff, John M., ―Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
5. N S Parthasarathy and Vela Murali, ―Engineering Graphics‖, Oxford University, Press, New Delhi, 2015.

GE3152	HERITAGE OF TAMILS	L	T	P	C
		1	0	0	1

UNIT I LANGUAGE AND LITERATURE 3

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 HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE 3

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 FOLK AND MARTIAL ARTS 3

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

UNIT IV THINAI CONCEPT OF TAMILS 3

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 CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE 3

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 PERIODS

TEXT BOOKS:

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

6 Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)

7. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)

8. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

U23HSP12	ENGLISH LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L 0	T 0	P 2	C 1

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

1. To improve the communicative competence of learners.
2. To help learners use language effectively in academic /work contexts.
3. To develop various listening strategies to comprehend various types of audio materials like lectures, discussions, videos etc.
4. To build on students' English language skills by engaging them in listening, speaking and grammar learning activities that are relevant to authentic contexts.
5. To use language efficiently in expressing their opinions via various media.

LIST OF EXPERIMENTS

1. Listening for general information-specific details
2. Conversation: Introduction to classmates
3. Speaking - making telephone calls-Self Introduction.
4. Talking about current and temporary situations & permanent and regular situations
5. Listening to podcasts, anecdotes / stories / event narration
6. Event narration; documentaries and interviews with celebrities
7. Events-Talking about current and temporary situations & permanent and regular situations
8. Engaging in small talk
9. Describing requirements and abilities- Picture description
10. Discussing and making plans
11. Talking about tasks- progress- positions -directions of movement
12. Talking about travel preparations and transportation
13. Listening to debates/ discussions
14. Making prediction talking about a given topic
15. Describing processes

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Identify and comprehend complex academic texts.

CO2: Interpret accurately and fluently in formal and informal communicative contexts.

CO3: Demonstrate their opinions effectively in both oral and written medium of communication.

CO4: Plan travelogue and construct paragraphs on various aspects.

CO5: Develop journal reading skills and small talk.

CO6: Utilizing technical terms and making power point presentations.

U23BSP11	PHYSICS AND CHEMISTRY LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn the proper use of various kinds of physics laboratory equipment.
2. To learn how data can be collected, presented and interpreted in a clear and concise manner.
3. To learn problem solving skills related to physics principles and interpretation of experimental data.
4. To determine error in experimental measurements and techniques used to minimize such error.
5. To make the student as an active participant in each part of all lab exercises.
6. To inculcate experimental skills to test basic understanding of water quality parameters, as, acidity, alkalinity, chloride.
7. To Induce the students to analyze the hardness of water
8. To induce the students to familiarize with electro analytical techniques such as, pH metry, conductometry in the determination of impurities in aqueous solutions.

LIST OF EXPERIMENTS

1. Torsion pendulum - Determination of rigidity modulus of wire and moment of inertia of regular disc.
2. Non - Uniform bending–Determination of Young's modulus.
3. Laser – (i) Determination of the wavelength of the laser using grating.
   (ii) Determination of size of the particles using laser source.
4. Air wedge – Determination of thickness of a thin sheet/wire.
5. Determination of Band gap of a semiconductor using PN junction kit.
6. To study the V-I Characteristics of Light Dependent Resistor (LDR).
7. Determination of types and amount of alkalinity in water sample.
8. Determination of total, temporary & permanent hardness of water by EDTA method.
9. Determination of chloride content of water sample by Argentometric method.
10. Determination of strength of given hydrochloric acid using pH meter.
11. Determination of strength of acids in a mixture of acids using conductivity meter.
12. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Torsion pendulum set up (Metal Disc, Symmetrical Mass(2x100g), Stop Clock, Screw Gauge)	5
2.	Non – Uniform bending set up (Travelling Microscope, Knife Edges, Weight Hanger with Mass(5x50g), Screw Gauge, Vernier Caliper, Meter Scale)	5
3.	Laser set up (Semiconductor Laser, Screen, Grating Stand, Wooden Stand With Meter Scale)	5
4.	Air wedge (Air Wedge Set Up, Travelling Microscope, Sodium Vapour Lamp, Transformer)	5
5.	Band gap of a semiconductor (PN Junction Kit, Thermometer, Heater, Beaker, Oil)	5
6.	Light Dependent Resistor (Power Supply, Voltmeter, Ammeter, LDR, Bulb, Resistors)	5

7.	PH meter	**5**
8.	Conductivity meter	**10**
9.	Common Apparatus (Pipette, Burette, Conical Flask, Porcelain tile, Dropper)	**15**

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the functioning of various physics laboratory equipment.
CO2: Observe and tabulate experimental data.
CO3: Solve problems individually and collaboratively.
CO4: Analyse the quality of water samples with respect to their acidity, alkalinity
CO5: Determine the amount of hardness in the water
CO6: Analyse quantitatively the impurities in solution by electro analytical techniques

U23GEP14	ENGINEERING PRACTICES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to provide hands on training to the students in:

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

GROUP – A (CIVIL AND MECHANICAL)

PART I CIVIL ENGINEERING PRACTICES PLUMBING WORK: 30

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

WELDING WORK:

a) Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
b) Practicing gas welding.

BASIC MACHINING WORK:

a) Turning
b) Drilling
c) Tapping

ASSEMBLY WORK:

a) Assembling a centrifugal pump.
b) Assembling a household mixer.

SHEET METAL WORK:

Making of a square tray

WOOD WORK:

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

PART II ELECTRICAL & ELECTRONICS 30

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

ELECTRONICS

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EX-OR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL = 60 PERIODS

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings. 15Sets.
2. Carpentry vice (fitted to work bench) 15Nos.
3. Standard woodworking tools 15 Sets.
4. Models of industrial trusses, door joints, furniture joints 5each
5. Power Tools: (a) Rotary Hammer 2 Nos (b) Demolition Hammer 2 Nos (c) Circular Saw 2 Nos (d) Planer 2 Nos (e) Hand Drilling Machine 2 Nos (f) Jigsaw 2Nos

MECHANICAL

Arc welding transformer with cables and holders 5 Nos.

1. Welding booth with exhaust facility 5 Nos.
2. Welding accessories like welding shield, chipping hammer, wire brush, etc. 5 Sets.
3. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit. 2 Nos.
4. Centre lathe 2 Nos.
5. Hearth furnace, anvil and smithy tools 2 Sets.
6. Moulding table, foundry tools 2 Sets.
7. Power Tool: Angle Grinder 2 Nos
8. Study-purpose items: centrifugal pump, air-conditioner One each

ELECTRICAL

1. Assorted electrical components for house wiring 15 Sets
2. Electrical measuring instruments 10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp 1 each
4. Megger (250V/500V) 1No.
5. Power Tools:
   a) Range Finder 2 Nos
   b) Digital Live-wire detector 2 Nos

ELECTRONICS

1. Soldering guns 10Nos.
2. Assorted electronic components for making circuits 50Nos.
3. Small PCBs 10Nos.
4. Multimeters 10Nos.

Study purpose items: Telephone, FM radio, low-voltage power supply.

COURSE OUTCOMES:

Upon completion of this course, the students will be able to:

CO1: Draw pipe line plan; lay and connect various pipe fittings used in common household plumbing work; Saw; plan; make joints in wood materials used in common household wood work.

CO2: Wire various electrical joints in common household electrical wire work.

CO3: Weld various joints in steel plates using arc welding work; Machine various simple processes like turning, drilling, tapping in parts; Assemble simple mechanical assembly of common Household equipments; Make a tray out of metal sheet using sheet metal work.

CO4: Solder and test simple electronic circuits; Assemble and test simple electronic components on PCB.

CO5: Apply fundamental engineering principles to analyse and solve real-world problems.

U23HST21	PROFESSIONAL ENGLISH COMMON TO ALL B.E. / B.TECH. PROGRAMMES	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. To engage learners in meaningful language activities to improve their reading and writing skills
2. To learn various reading strategies and apply in comprehending documents in professional context.
3. To help learners understand the purpose, audience, contexts of different types of writing.
4. To enable students write letters and reports effectively in formal and business situations.
5. To demonstrate an understanding of job applications and interviews for internship and placements.

UNIT I PREPARATORY DOCUMENTATIONS 9

Listening- Listening to formal conversations and Participating. Speaking- speaking about one's family. Reading – Summary of W.W Jacobs "The monkey's paw". Writing – Subject verb Agreement, Numerical -Adjectives, Kinds of sentences, Writing reviews (book / film), writing Instructions, Writing Recommendation.

UNIT II LECTURA ENRICHMENT AND PASSAGE COMPOSE 9

Listening- listening to lectures on academic topics; Speaking- Asking for and giving directions. Reading - Reading longer technical texts; Writing - Compound words, Homophones and Homonyms, Cause and Effect expressions. Essay Writing, Writing Letter to the Editor (complaint, acceptance, Requesting, Thanking).

UNIT III ANALYTICAL SKILL 9

Listening- Watching videos/documentaries and responding to questions based on them. **Speaking –** Speaking about ones favourite place**. Reading –** Summary of the poem – John keats "Ode to a Nightingale". **Writing-** Purpose statement, Extended Definitions. Writing Job/ Internship application – Cover letter & Resume.

UNIT IV REPORT WRITING 9

Listening- Listening to class room lectures/talks on engineering/technology. **Speaking–** Introduction to technical presentations. **Reading –** Newspaper articles; **Writing –** Comparative Adjectives Direct and Indirect speech**.** Report Writing- Fire Accident Report, Road Accident, Feasibility Report).

UNITV ENABLING LINGUA IDEALITY & INFORMATION 9

Listening- TED/Ink talks. **Speaking –** Making presentation on a given topic. **Reading –**Company profiles, Statement of Purpose, (SOP), **Writing –** Relative Clauses, If conditions, Cause and Effect. Chart Interpretations - Bar Chart, Pie Chart, Flow Chart & Tables.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Compare and contrast products and ideas in technical texts.

CO2: Identify cause and effects in events, industrial processes through technical texts.

CO3: Analyze problems in order to arrive at feasible solutions and communicate them orally and in the written format.

CO4: Motivate students to write reports and winning job applications.

CO5: Recall and comprehend different discourses and genres of texts.

CO6: Making the students to become virtuous presenters.

TEXT BOOKS:

1. English for Engineers & Technologists (2020 edition) Orient Blackswan Private Ltd. Department of English, Anna University.
2. English for Science & Technology Cambridge University Press 2021.
3. Authored by Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University.

REFERENCE BOOKS:

1. Raman. Meenakshi, Sharma. Sangeeta (2019). ta. Oxford university press. New Delhi.
2. Improve Your Writing ed. V.N. Arora and Laxmi Chandra, Oxford Univ. Press, 2001, New Delhi.
3. Learning to Communicate – Dr. V. Chellammal. Allied Publishers, New Delhi, 2003
4. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001, New Delhi.
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi.

SEMESTER- II

		L	T	P	C
U23MAT22	**STATISTICS AND NUMERICAL METHODS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. This course aims at providing the necessary basic concepts of a few statistical tools and give procedures for solving different kinds of problems occurring in engineering and technology.
2. To acquaint the knowledge of classifications of design of experiments in the field of agriculture.
3. To introduce the basic concepts of solving algebraic and transcendental equations.
4. To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.
5. To acquaint the knowledge of various techniques and methods of solving ordinary differential equations.

UNIT I TESTING OF HYPOTHESIS 12

Introduction – Sampling distributions – Tests for single mean, proportion and difference of means (Large and small samples) – Tests for single variance and equality of variances – Chi square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 12

Introduction – Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design.

UNIT III SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS 12

Solution of algebraic and transcendental equations – Fixed point iteration method – Newton Raphson method – Solution of linear system of equations – Gauss elimination method – Gauss Jordan method – Iterative methods of Gauss Jacobi and Gauss Seidel - Eigen Value of a matrices by power method and jacobi's method for Symmetric matrices.

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION 12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical single and double integrations using Trapezoidal and Simpson's 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 12

Single step methods : Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge – Kutta method for solving first order differential equations – Multi step methods : Milne's and Adams Bashforth predictor corrector methods for solving first order differential equations.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO2: Apply the basic concepts of classifications of design of experiments in the field of agriculture.

CO3: Solve the algebraic and transcendental equations.

CO4: Understand the knowledge of numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.

CO5: Solve the ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

CO6: Understand the knowledge of various techniques and methods for solving first and second order ordinary differential equations.

TEXT BOOKS:

1. Grewal, B.S., and Grewal, J.S., "Numerical Methods in Engineering and Science", Khanna Publishers, 10 th Edition, New Delhi, 2015.
2. Johnson , R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.

REFERENCES BOOKS :

1. Burden,R.L and Faires, J.D, "Numerical Analysis", 9th Edition, Cengage Learning, 2016.
2. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi , 8th Edition, 2014.
3. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis" Pearson Education, Asia, New Delhi, 7th Edition, 2007.
4. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi,12th Edition, 2020.
5. Spiegel.M.R.,Schiller.J. and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", Tata McGraw Hill Edition, 4th Edition, 2012C

	PHYSICS OF MATERIALS	L	T	P	C
U23PHT26	(COMMON TO AGRI, BME, BIOTECH, CHEM, FOOD PHARMA PROGRAMMES)	3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To make the students to understand the basics of crystallography and its importance in studying materials properties.
2. To expand their knowledge in applications of magnetic and superconducting materials in small scale industries.
3. To inculcate an idea of significance of new materials, nanostructures ensuing nano device applications.

UNIT I CONDENSED MATTER PHYSICS 9

Introduction - Lattice - Unit Cell - Seven Crystal Systems -Bravai's Lattices - Lattice Planes - Calculation of Number of Atoms per Unit Cell, Atomic Radius, Coordination Number and Packing Factor for SC, BCC, FCC and HCP Structures. Miller Indices – Derivation for Inter-Planar Spacing in terms of Miller Indices-Crystal Growth Techniques: Melt Growth Technique (Bridgman and Czochralski Techniques).

UNIT II MAGNETIC AND SUPER CONDUCTING MATERIALS 9

Magnetic Materials: Dia, Para and Ferromagnetic Materials and Its Properties – Ferromagnetic Domains – Wiess Theory of Ferromagnetism – Hysteresis - B-H Curve Studies – Soft and Hard Magnetic Materials- Applications. Super Conducting Materials: Properties – Type I and Type II Super Conductors – London equations – Applications: Magnetic Levitated Train – Magnetic Resonance Imaging.

UNIT III MODERN ENGINEERING MATERIALS 9

Shape Memory Alloys – Structures – Properties – Applications. Metallic Glasses – Preparation and Applications. Ceramics – Types - Properties and Applications.

Nano Materials – Types – Properties and Applications – Preparation Techniques: Electrodeposition – Pulsed Laser Deposition. CNT – Structure – Types – Properties - Applications

UNIT IV INSTRUMENTATION PHYSICS 9

X – rays – Production – Diffraction of X – rays – Laue'e experiment – Bragg's law – Bragg's X – ray Spectrometer – Diffraction methods – Laue method – Rotating Crystal method – Powder Crystal method. Optical microscope – Electron microscope – Scanning electron microscope – Transmission electron microscope – EDAX – FTIR.

UNIT V RADIOACTIVE MATERIALS 9

Nucleus: Classification, Properties – Radioactivity – Alpha, Beta and Gamma rays – Properties – Laws of disintegration – Half-life period – Mean life -Neutron and its properties. Artificial radioactivity – Applications and hazards of nuclear radiations – Detectors of Nuclear radiations: Solid State detectors – Proportional Counter – Geiger-Muller Counter.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Know basics of crystallography and its importance for varied materials properties.

CO2: Gain knowledge on the magnetic and superconductor properties of materials and their applications.

CO3: Illustrate the SMA and metallic glasses.

CO4: Gain knowledge in the development of instruments.
CO5: Get knowledge about radioactive materials.
CO6: Understand the concept of detectors and counters.

TEXT BOOKS:

1. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019
2. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition),2009.
3. Dr. P. Mani, "Physics for Electronics Engineering" Dhanam Publications, 2017.
4. Dr. G. Senthilkumar, "Engineering Physics II" VRB Publishers, 2013.

REFERENCE BOOKS:

1. Robert F.Pierret, Semiconductor Device Fundamentals, Pearson, 2006
2. S. Rajivgandhi, Dr. I. Cicil Ignatius & A. Ravikumar, " Engineering Physics II", RK Publications, 2023
3. Ben Rogers, Jesse Adams and Sumita Pennathur, Nanotechnology: Understanding Small Systems, CRC Press, 2017.
4. Dr. G. Senthilkumar, A. Ravikumar & S. Rajivgandhi, " Engineering Physics II", VRB Publishers, 2023

U23GET15	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

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

UNIT I COMPUTATIONAL THINKING AND PROBLEM SOLVING 9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, guess an integer number in a range, Towers of Hanoi.

UNIT II DATA TYPES, EXPRESSIONS, STATEMENTS 9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III CONTROL FLOW, FUNCTIONS, STRINGS 9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV LISTS, TUPLES, DICTIONARIES 9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNITV FILES, MODULES, PACKAGES 9

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs
CO3: Write simple Python programs using conditionals and looping for solving problems
CO4: Decompose a Python program into functions
CO5: Represent compound data using Python lists, tuples, dictionaries etc
CO6: Read and write data from/to files in Python programs

TEXT BOOKS:

1. Allen B. Downey, “Think Python : How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and programming”, 1st Edition, BCS Learning & Development Limited, 2017.

REFERENCE BOOKS:

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data‘‘, Third Edition, MIT Press ,2021
4. Eric Matthes, “Python Crash Course, A Hands - on Project Based Introduction to Programming”, 2nd Edition, No Starch Press, 2019.

U23EET25	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. the basics of electric circuits and analysis
2. The impart knowledge in domestic wiring
3. The impart knowledge in the basics of working principles and application of electrical Machines
4. Analog devices and their characteristics
5. The functional elements and working of sensors and transducers

UNIT I ELECTRICAL CIRCUITS 9

Basic circuit components -Ohms Law Kirchhoff's Law – Instantaneous Power – Inductors - Capacitors– Independent and Dependent Sources-steady state solution of DC circuits-Nodal analysis, Mesh analysis-Thevinin's Theorem, Norton's Theorem, Maximum Power transfer theorem- Linearity and Superposition Theorem.

UNIT II AC CIRCUITS 9

Introduction to AC circuits–waveforms and RMS value–power and power factor, single phase and three-phase balanced circuits–Three phase loads-housing wiring, industrial wiring, and materials of wiring. safety precautions and First Aid.

UNIT III ELECTRICAL MACHINES 9

Construction and Working principle- DC Separately Generators, EMF equation, Types and Applications. Working Principle of DC motors, Torque Equation, Types and Applications. Construction, Working principle and Applications of Transformer, Synchronous motor and Three Phase Induction Motor.

UNIT IV ANALOG ELECTRONICS 9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode – Characteristics Applications – Bipolar Junction Transistor-Biasing, JFET, SCR, MOSFET,IGBT – Types, I-V Characteristics and Applications, Rectifier and Inverters, harmonics

UNITV SENSORS AND TRANSDUCERS 9

Sensors, solenoids, pneumatic controls with electrical actuator, mechatronics, types of valves and its applications, electro-pneumatic systems, proximity sensors, limit switches, piezoelectric, hall effect, photo sensors, Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Compute the electric circuit parameters for simple problems.
CO2: Explain the concepts of domestics wiring.
CO3: Explain the concepts of protective devices.
CO4: Explain the working principle and applications of electrical machines.
CO5: Analyze the characteristics of analog electronic devices.
CO6: Explain the types and operating principles of sensors and transducers

TEXT BOOKS:

1. D P Kothari and I.J Nagarath, "Basic Electrical and Electronics Engineering", McGraw Hill Education (India) Private Limited, Second Edition, 2020.
2. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai and Co, 2015.
3. S.K. Bhattacharya, Basic Electrical Engineering, Pearson Education, 2019
4. James A Svoboda, Richard C. Dorf, Dorf's Introduction to Electric Circuits, Wiley,2018

REFERENCE BOOKS:

1. John Bird, "Electrical Circuit theory and technology", Routledge; 2017.
2. Thomas L. Floyd, 'Electronic Devices', 10th Edition, Pearson Education, 2018.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017
4. Muhammad H.Rashid, "Spice for Circuits and electronics", 4th Edition., Cengage India,2019.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010.

GE3252	தமிழரும் தொழில்நுட்பமும் /TAMILS AND TECHNOLOGY	L	T	P	C
		1	0	0	1

UNIT I WEAVING AND CERAMIC TECHNOLOGY 3

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

UNIT II DESIGN AND CONSTRUCTION TECHNOLOGY 3

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 MANUFACTURING TECHNOLOGY 3

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 AGRICULTURE AND IRRIGATION TECHNOLOGY 3

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.

UNITV SCIENTIFIC TAMIL & TAMIL COMPUTING 3

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 PERIODS

TEXT BOOKS:

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

U23EEP24	BASIC ELECTRICAL, ELECTRONICS AND INSTRUMENTATION ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Conducting load tests electrical machines
2. Practical experience in experimentally obtaining the characteristics of electronic Devices
3. Experimentally obtaining the characteristics of rectifiers
4. To train the students to measure three phase power
5. To train the students to measure three phase displacement

LIST OF EXPERIMENTS

1. Verification of ohms and Kirchhoff's Laws.
2. Three Phase Power Measurement
3. Load test on DC Shunt Motor.
4. Load test on Self Excited DC Generator
5. Load test on Single phase Transformer
6. Load Test on Induction Motor
7. Characteristics of PN and Zener Diodes
8. Characteristics of BJT, SCR and MOSFET
9. Design and analysis of Half wave and Full Wave rectifiers
10. Measurement of displacement of LVDT

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	DC Regulated Power supply (0 - 30 V)	1
2.	Three Phase Variable Load	1
3.	DC Shunt Motor	1
4.	DC Shunt Motor coupled with DC shunt Generator	1
5.	Single phase Induction motor	1
6.	PN Diode and Zener diode	1
7.	Transistor, SCR and MOSFET	1
8.	Diodes	1
9.	LVDT Kit	1
10.	Ammeters	As Required
11.	Voltmeters	As Required
12.	Rheostat	As Required
13.	Tachometer	As Required
14.	Connecting wires	As Required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Use experimental methods to verify the Ohm's law
CO2: Use experimental methods to verify the Kirchhoff's Law
CO3: Use experimental methods to measure three phase power

CO4: Analyze experimentally the load characteristics of electrical machines
CO5: Analyze the characteristics of basic electronic devices
CO6: Use LVDT to measure displacement

U23HSP22	COMMUNICATION LABORATORY (COMMON TO ALL B.E. / B.TECH. PROGRAMMES)	L	T	P	C
		0	0	2	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

To identify varied group discussion skills and apply them to take part in effective discussions in a professional context
To be able to communicate effectively through writing
Encouraging plan designing and decision making
Understanding and writing technical instruction
To understand the value of letter writing with correct format

LIST OF EXPERIMENTS:

Speaking-Role Play Exercises Based on Workplace Contexts
Talking about competition
Discussing progress toward goals-talking about experiences
Discussing likes and dislikes
Discussing feelings about experiences
Discussing imaginary scenarios
Writing short essays.
Speaking about the natural environment.
Describing communication system.
Describing position and movement- explaining rules.
Understanding technical instructions-Writing: writing instructions.
Speaking: describing things relatively-describing clothing.
Discussing safety issues (making recommendations) talking about electrical devices.
Describing controlling actions.
Writing a job application (Cover letter + Resume).

TOTAL: 30 PERIODS

EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Communication laboratory with sufficient computer systems	**30**
2.	Server	**1**
3.	Head phone	**30**
4.	Audio mixture	**1**
5.	Collar mike	**1**
6.	Television	**1**
7.	Speaker set with amplifier	**1**
8.	Power point projector and screen	**1**
9.	Cordless mike	**1**

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1: Distinguish their technical competency through language skill.
CO2: Predict context effectively in-group discussions held in a formal / semi-formal discussions.
CO3: Understanding candidates' key characteristics.
CO4: Finding personality traits by sharing and comparing thoughts and ability.
CO5: Understanding the value of ethics.(rules and regulations).
CO6: Construct emails and effective job applications**.**

U23GEP13	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main learning objective of this course is to prepare the students for:

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

LIST OF EXPERIMENTS:

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building – operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (Reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (Copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (Divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to:

CO1: Develop algorithmic solutions to simple computational problems
CO2: Develop and execute simple Python programs.
CO3: Implement programs in Python using conditionals and loops for solving problems.
CO4: Deploy functions to decompose a Python program.
CO5: Process compound data using Python data structures.
CO6: Utilize Python packages in developing software applications.

SEMESTER III

		L	T	P	C
U23MAT31	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS**	**3**	**1**	**0**	**4**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
2. To introduce the basic concepts of PDE for solving standard partial differential equations.
3. To acquaint the student with Fourier series techniques in solving heat flow problems used in various situations.
4. To acquaint the student with Fourier transform techniques used in wide variety of situations.
5. To enable the students to study the Laplace transforms and some applications to solve the differential equations.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 12

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions – Lagrange's linear equation – Solution of homogeneous linear partial differential equations of higher order with constant coefficients of both homogenous and non – homogenous type.

UNIT II FOURIER SERIES 12

Dirichlet's conditions – General Fourier series – Odd and even functions–Half range sine series and cosine series – Parseval's identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 12

Classification of PDE – Method of separation of variables - Fourier series solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (Cartesian coordinates only).

UNIT IV FOURIER TRANSFORMS 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V LAPLACE TRANSFORMS 12

Existence conditions – Transforms of elementary functions – Transform of unit step function and unit impulse function – Basic properties – Shifting theorems – Transforms of derivatives and integrals - Initial and final value theorems – Inverse transforms – Convolution theorem–Transform of periodic functions – Application to solution of linear second order ordinary differential equations with constant coefficients.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand how to solve the given standard partial differential equations.

CO2: Solve differential equations using Fourier series analysis which plays a vital role in engineering applications

CO3: Appreciate the physical significance of Fourier series techniques in solving One and two dimensional heat flow problems and one dimensional wave equations

CO4: Understand the mathematical principles on transforms would provide them the ability to formulate and solve some of the physical problems of engineering.

CO5: Use the method of Laplace Transform to solve initial value problem for Linear differential equations with constant coefficients.

CO6: To study the Laplace Transforms, properties of Laplace Transform and some applications to solve the differential equations and integral equations.

TEXT BOOKS:

1. Grewal B.S., “Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi ,2018.
2. Kreyszig E, "Advanced Engineering Mathematics, 10th Edition, John Wiley, New Delhi, India,2016.
3. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.

REFERENCE BOOKS:

1. Andrews. L.C and Shivamoggi. B, "Integral Transforms for Engineers "SPIE Press,1999.
2. Bali. N.P and Manish Goyal, "A Text book of Engineering Mathematics”, 10th Edition, Laxmi Publications Pvt. Ltd ,2015.
3. James. G., "Advanced Modern Engineering Mathematics", 4th Edition, Pears on Education, New Delhi,2016.
4. Narayanan. S., Manicavachagom Pillay. T.K and Ramanaiah. G “Advanced Mathematics for Engineering Students",Vol. II & III, S.Viswanathan Publishers Pvt. Ltd, Chennai, 1998.
5. Ramana. B.V., "Higher Engineering Mathematics", McGraw Hill Education Pvt. Ltd, NewDelhi,2018.

U23FTT31	FOOD PROCESS CALCULATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn various units, dimensions and unit conversions
2. To learn about humidity and use of Psychometric chart
3. To learn about material balance involved in the food processing
4. To learn about energy balance involved in the food processing
5. To learn about combustion of solids, liquids and gases, calculations of excess of air

UNIT I UNITS AND DIMENSIONS, FUNDAMENTAL CALCULATIONS 9

Basic and derived units, unit conversions, use of model units in calculations, methods of expression, compositions of mixture and solutions. Ideal and real gas laws – gas constant - calculations of pressure, volume and temperature using ideal gas law, Use of partial pressure and pure component volume in gas calculations, applications of real gas relationship in gas calculation.

UNIT II HUMIDITY 9

Calculation of absolute humidity, molal humidity, relative humidity and percentage humidity - Use of humidity in condensation and drying - Humidity chart, dew point.

UNIT III MATERIAL BALANCE 9

Introductory Concepts, Simplification of the general mass balance equation for steady and unsteady state processes, Procedure for material balance calculations, Material balance without chemical reactions, humidification such as continuous filtration, batch mixing, crystallizer, distillation column. Material balance with chemical reaction: Stoichiometry of growth and product formation: growth stoichiometry and elemental balances.

UNIT IV ENERGY BALANCE 9

General energy balance equation for steady and unsteady state processes: Without Chemical Reaction, With Chemical Reaction, Enthalpy calculation procedures, Special cases e.g., spray dryer, Distillation Column.

UNIT V COMBUSTION 9

Combustion: Combustion of solids, liquid and gas, determination of NHV and GHV. Determination of composition by Orsat analysis - Calculation of excess air, theoretical oxygen requirement.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply different systems of units and dimensions
CO2: Estimate compositions of mixtures andsolutions
CO3: Perform humidification calculations
CO4: Apply material balance for different unit operations
CO5: Perform energy balance calculations
CO6: Determine the GHV, NHV and composition of fuels

TEXT BOOKS:

1. GavhaneK.A., "Introduction to Process Calculations (Stoichiometery)", 22nd Edition, NiraliPrakashan Publications, Pune, 2018.
2. Venkataramani V. and Anantharaman N., "Process Calculations", Prentice Hall of India, NewDelhi, 11th edition 2011

3. Himmelblau, D.M., “Basic Principles and Calculations in Chemical Engineering”, Eighth Edition, Prentice Hall India, New Delhi, 2015.

REFERENCE BOOKS:

1. Bhatt B.L. and Vora S.M., ―Stoichiometry‖, 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 5 th edition 2010
2. Himmelblau D.M., ―Basic Principles and Calculations in Chemical Engineering‖, 6th Edition,Prentice Hall of India, New Delhi, 8th Edition 2016
3. Narayanan K.V. and Lakshmikutty B., ―Stoichiometry and Process Calculations‖, Prentice Hall of India, New Delhi, 2 nd edition 2016.

U23FTT32	BIOCHEMISTRY AND NUTRITION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop knowledge on basics of nutrition for Diet planning based on RDA
2. To understand functional role of carbohydrates and its health effects.
3. To understand the basic concepts of biochemistry
4. To gain knowledge on protein quality assessment and functional role of lipids
5. To understand the physiological role of vitamins and minerals

UNIT I AN OVERVIEW OF NUTRITION **9**

Definition, six classes of nutrients, RDA, nutritional status and its assessment, nutritional requirement, malnutrition – over nutrition and under nutrition. Balanced diet: Diet planning principles, dietary guidelines; food groups; Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption and transport of nutrients

UNIT II CARBOHYDRATES **9**

Sugars, Starch and Fiber: Digestion and absorption of carbohydrates physiological functions and metabolism (Glycolysis, Gluconeogenesis, Glycogenolysis), lactose intolerance; Glycemic and Non-glycemic carbohydrates, recommendations of sugar intake for health, health effects of fiber and starch intake, Artificial sweeteners- Nutrition and Diabetes, GTT, Health implications of high carbohydrate diets, Recommended Dietary Allowances, Dietary recommendations for NIDDM and IDDM.

UNIT III PROTEINS & LIPIDS **9**

Protein: Chemical Composition, Properties, Classification– nutritional classification of proteins and amino acids, Physiological function, Digestion and Absorption, Quality of proteins, scoring systems, Complementary value of proteins, Requirements, Recommended Dietary Allowances, Protein Energy Malnutrition - Marasmus and Kwashiorkor. Lipid: Chemical composition, Classifications, Fats in body, Fats in food, Physiological functions, Digestion and Absorption, Intestinal resynthesis of triglycerides, Types of fatty acids: Role and nutritional significance (SFA, MUFA, PUFA), Recommended Dietary Allowances, Health implications of high fat diet.

UNIT IV VITAMINS & MINERALS **9**

Water & Fat Soluble Vitamins- Sources, Functions, absorption and metabolism, Factors affecting absorption of vitamins, Deficiency, Recommended Dietary Allowances. Macro minerals (Calcium, Phosphorus)- Functions, Absorption and metabolism, Factors affecting bioavailability, Sources, Deficiency, Overdose toxicity, Recommended Dietary Allowances. Micro minerals (Iron, Iodine) - Functions, Absorption and metabolism, Factors affecting bioavailability, Sources, Deficiency, Overdose toxicity, Recommended Dietary Allowances.

UNITV ENERGY METABOLISM **9**

Energy Balance: Definition, units, Determination of energy values of foods, Determination of energy requirements, Basal Metabolic Rate, Measurement of basal metabolism, Resting Energy metabolism, non-caloric methods, Thermic effect of foods, Factors affecting thermic effect of foods, Recommended Dietary Allowances for energy. Health implications of high energy foods: Obesity, BMI calculations, Weight Control; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviours toward weight control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply knowledge of nutrition in diet planning.
CO2: Provide the dietary recommendations for NCD's
CO3: Asses the quality of proteins and lipids from various sources.
CO4: Comprehend the physiological and toxicological effects of vitamins and minerals.
CO5: Apply the learnt techniques to assess the lifestyle related NCD's.
CO6: Asses the Health implications of high energy foods

TEXT BOOKS:

1. B. Srilakshmi. "Nutrition Science". II Edition, New Age International (P) Ltd., 2002.
2. Mann, Jim and Stewart Truswell "Essentials of Human Nutrition". 3rd Edition. Oxford University Press, 2007.
3. Gibney, Michael J., et al., "Introduction to Human Nutrition". 2nd Edition. Blackwell,2009.
4. Gropper, Sareen S. and Jack L. Smith "Advanced Nutrition and Human Metabolism". 5th Edition. Wadsworth Publishing, 2008.

REFERENCE BOOKS:

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. "Nutritive Value of Indian Foods". NIN, ICMR, 2004.
2. Owusu-Apenten, Richard. "Introduction to Food Chemistry". CRC Press, 2005.

U23FTT33	UNIT OPERATIONS IN FOOD PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand Principles of separation methods used in the process industry.
2. To appreciate different equipments developed for separation

UNIT I SIZE REDUCTION IN FOOD PROCESSING 9

Characterisation of solid particles – Mixing of solids – equipments – storage of solids – size reduction of solids – Crushing, grinding Cutting-Power requirements-equipments- size enlargement.

UNIT II FLUID – SOLID SEPARATION FOOD PROCESSING 9

Separation of solids & suspension from gas medium-screening- settling- Principles and equipments-classification-clarification.

UNIT III FILTRATION FOOD PROCESSING 9

Filtration – Principles –Equipments-Centrifugal filtration-Principles- equipments – Centrifugal separation of immiscible liquids.

UNIT IV MEMBRANE SEPARATION FOOD PROCESSING 9

Cross flow filtration- Membranes –Ultrafiltration-Microfiltration-Concentration Polarisation - operation and equipments.

UNIT V DRYING & CRYSTALLISATION FOOD PRODUCTS 9

Principles of Drying – Drying equipments Principles of Crystallisation- crystallization equipments. Problems related to drying and crystallization of food products.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: To understand the knowledge of size reduction in food processing unit
CO2: To understand the concept of mass and energy balance
CO3: To apply unit operations to the design and operation of food processing plants
CO4: To understand the role of unit operations in food safety and quality
CO5: To perform basic calculations of relevant unit operations
CO6: To apply the concepts in computer software to simulate food processing operations

TEXT BOOKS:

1. Geankoplis, C.J. “Transport Processes and Separation Process Principles”, 4th Edition, Prentice Hall, 2003.
2. McCabe W.L., Smith J.C. “Unit Operations in Chemical Engineering”, 7th Edition, McGraw – Hill Int., 2001
3. Richardson, J.E. etal., “Coulson & Richardson’s Chemical Engineering” Vol.2 (Particle Technology & Separation Processes”) 5th Edition, Butterworth – Heinemann / Elsevier, 2003

U23FTT34 **POST HARVEST ENGINEERING** **L T P C**
3 0 0 3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop the knowledge of students in the area of post-harvest processing of various foods and related technology.
2. To enable students to appreciate the application of scientific principles in the processing of post harvesting materials.

UNIT I INTRODUCTION **9**

Overview of post-harvest technology: Concept and science, production and post-harvest losses, reasons for losses, importance of loss reduction; Post Harvest Handling operations. Pre-drying operation, Moisture content, RH measurement, air-grain measurement.

UNIT II CLEANING, SORTING AND GRADING **9**

Cleaning: Cleaning of grains, washing of fruits and vegetables, types of cleaners, screens, types of screens, rotary screens, vibrating screens, machinery for cleaning of fruits and vegetables (air cleaners, washers). Sorting and grading: Sorting, grading, methods of grading; Grading- Size grading, colour grading, screening, equipment for grading of fruits and vegetables, grading efficiency.

UNIT III MATERIAL HANDLING **9**

Study of different material handling systems: Classification, principles of operation, conveyor system selection/design; Belt conveyor, Chain conveyor, Screw conveyor, Bucket elevator, Pneumatic conveying system.

UNIT IV PRINCIPLES AND PRACTICE OF STORAGE **9**

Storage: Importance of scientific storage systems, post-harvest physiology of semi-perishables and perishables. Damages: Direct damages, indirect damages, causes of spoilage in storage (moisture, temperature, humidity, respiration loss, heat of respiration, sprouting), destructive agents (rodents, birds, insects, etc.), sources of infestation and control.

UNIT V PEST CONTROL **9**

Primary and secondary insect pests, rodents and microorganisms of stored food grains and their control, integrated pest management, Fumigation and controlled atmosphere storage of food grains, Rodent Control.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply the post-harvest engineering to prevent loss.
CO2: Infer the different cleaning, threshing and grading operations involved in food industry.
CO3: Utilize the conveyors in the food industry
CO4: Apply the storage principles in extending the shelf-life of commodity.
CO5: Identify the primary and secondary microorganisms of stored food grains
CO6: Identify the suitable pest control and management method for agricultural produce.

TEXT BOOKS:

1. Sahay, K. M. and K. K. Singh. "Unit operation of Agricultural Processing", Vikas Publishing
   House., Pvt Ltd. 2004.
2. Postharvest Technology of Horticultural Crops by Adel Kader
3. Chakravarty et al Handbook of Post-Harvest Technology Marcel Dekker. 2003.

REFERENCE BOOKS:

1. Postharvest Technology and Food Process Engineering by Amalendu Chakraverty and R. Paul Singh
2. Earle, R.L, "Unit Operations in Food Processing". Pergamon Press. Oxford. U.K, 2003.

U23GET41	ENVIRONMENTAL SCIENCES AND ENGINEERING	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To the study of nature and the facts about environment
2. To finding and implementing scientific, technological, economic and political solutions to environmental problems
3. To study the interrelationship between living organism and environment.
4 To appreciate the importance of environment by assessing its impact on the human world envisions the surrounding environment, its functions and its value
5 To study the integrated themes and biodiversity, natural resources, pollution control and waste Management.

UNIT I ECOSYSTEM AND BIODIVERSITY 9

Definition, Scope and importance of environment – Need for public awareness. Eco-system- Types and Energy flow– Ecological succession. Types of biodiversity: genetic, species and ecosystem diversity – values of biodiversity, India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ.

UNIT II ENVIRONMENTAL POLLUTION 9

Causes, Effects and Preventive measures of Water, Soil, Air and Noise Pollutions. Solid, Hazardous and E-Waste management. Case studies on Occupational Health and Safety Management system (OHASMS). Environmental protection, Environmental protection acts.

UNIT III RENEWABLE SOURCES OF ENERGY 9

Energy management and conservation, New Energy Sources: Need of new sources. Different types new energy sources. Applications of- Hydrogen energy, Ocean energy resources, Tidal energy conversion. Concept, origin and power plants of geothermal energy.

UNIT IV ENVIRONMENTAL ISSUES 9

Social Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust - Population growth, variation among nations population explosion – family welfare programme – human rights – value education – HIV / AIDS – women and child welfare.

UNIT V SUSTAINABILITY PRACTICES 9

Zero waste and R concept, Circular economy, ISO 14000 Series, Material Life cycle assessment, Environmental Impact Assessment. Sustainable habitat: Development, GDP, Sustainability- Green buildings, Green materials, Energy efficiency, Sustainable transports. Sustainable energy Non-conventional Sources, Energy Cycles- carbon cycle, emission and sequestration, Green Engineering: Sustainable urbanization- Socio- economic and technological change.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Environmental Pollution or problems cannot be solved by mere laws.

CO2: Public participation is an important aspect which serves the environmental Protection.

CO3: Public awareness of environmental is at infant stage.

CO4: Ignorance and incomplete knowledge has lead to misconceptions

CO5: Development and improvement in std. of living has lead to serious environmental

Disasters

CO6: Establish the Sustainability Practices

TEXT BOOKS:

1. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, 2016.
2. Gilbert M. Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education, 2004.
3 Allen, D. T. and Shonnard, D. R., Sustainability Engineering: Concepts, Design and Case Studies, Prentice Hall.
4. Dr. J. Manivel and Dr. A. Arunkumar, "Environmental Science & Engineering" R.K. Publishers, 1st Edition 2023

REFERENCE BOOKS:

1. R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media. 38.
2. Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3. Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press, 2005.

U23FTP31	BIOCHEMISTRY AND NUTRITION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn basic measurement in food biochemistry.
2. To learn basic chemical analysis
3. To understand basic chemistry involved in food testing.
4. To gain knowledge in anthropometry.
5. To understand the different clinical requirements.

LIST OF EXPERIMENTS

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

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Colorimeter	1
2.	UV- Visible Spectrophotometer	1
3.	Weighing Scale	1
4.	Stadiometer	1
5.	Skin Fold Calipers	1
6.	Analytical Weighing Balance	2
7.	Glassware / Chemicals	As required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Learn basic measurement in food processing.
CO2: Learn the basic chemical analysis
CO3: Apply the learnt basic chemistry involved in food testing.

CO4: Assess the nutritional anthropometry
CO5: Assess the clinical status of the individuals.
CO6: Assess the nutrient composition of foods.

U23FTP32	UNIT OPERATIONS IN FOOD PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop knowledge in handling basic operation equipment's.
2. To develop knowledge in handling equipments used in food industries.
3. To develop knowledge in equipment's working principle.
4. To evaluate the performance of various equipments used in food industries.
5. To analyse the working of different equipments used in food industries.

LIST OF EXPERIMENTS

1. Flow measurement a) Orifice meter b) Venturimeter, c) Rotameter
2. Solving problems on single effect evaporator and multiple effect evaporator
3. Solving problems on filtration and distillation
4. Determination of economy and thermal efficiency of flash evaporator
5. Determination of separation efficiency of centrifugal separator
6. Determination of efficiency of liquid solid separation by filtration
7. Determination of particle size of granular foods by sieve analysis
8. Determination of energy requirement in size reduction using ball mill
9. Performance evaluation of pin mill
10. Performance evaluation of a hammer mill
11. Performance evaluation of a steam distillation process
12. Visit to a sugar industry

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl No	Name of the Equipment	Quantity
1.	Orifice meter	1
2.	Venturimeter	1
3.	Rotameter	1
4.	Centrifugal separator	1
5.	Flash evaporator	1
6.	Sieve analyser	1
7.	Pin mill	1
8.	Hammer mill	1
9.	Steam distillation	1
10.	Glassware / Chemicals	As required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: The basic principles of chemical Demonstrate engineering and its applications.

CO2: Apply the skill of material balance and energy balance in unit operations unit Process

CO3: To develop knowledge on the basic principles of chemical engineering and its applications.

CO4: Be able to apply the skill of material balance in unit operations unit process

CO5: Be able to apply the skill energy balance in unit operations unit process

CO6: Demonstrate the working of different equipments

SEMESTER IV

U23MAT42	PROBABILITY AND OPERATIONS RESEARCH	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the basic concepts of probability, one and two dimensional random Variables.
2. To introduce two dimensional random variables applicable to engineering which can describe real life phenomenon.
3. To have knowledge in solving linear programming models.
4. To acquaint knowledge to solve transportation and assignment problems.
5. To familiar with the method of solving nonlinear programming models.

UNIT I PROBABILITY AND RANDOM VARIABLES **12**

Axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions - Functions of a random variable.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem.

UNIT III LINEAR PROGRAMMING MODELS **12**

Formulation of linear programming models – Graphical solution – Simplex method -Big M Method – Two phase simplex method - Duality - Dual simplex method.

UNIT IV TRANSPORTATION AND ASSIGNMENT PROBLEMS **12**

Matrix form of Transportation problems – Loops in T.P – Initial basic feasible solution– Transportation algorithm – Assignment problem – Unbalanced assignment problems.

UNIT V NON - LINEAR PROGRAMMING MODELS **12**

Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn –Tucker Conditions – Quadratic programming.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1:	Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.
CO2:	Understand the basic concepts of two dimensional random variables and apply in engineering applications.
CO3:	Develop a fundamental understanding of linear programming models, able to develop a linear programming model from problem description.
CO4:	Apply the Simplex method for solving linear programming problems.
CO5:	Analyze the concept of developing, formulating, modeling and solving transportation and assignment problems.
CO6:	Determine the optimum solution for non-linear programming problems.

TEXT BOOKS:

1. Ross. S.M., “Introduction to Probability and Statistics for Engineers and Scientists”, Elsevier, New Delhi, 5th Edition, 2014.
2. H.A. Taha," Operations Research, An introduction ,10th Edition, Pearson Education, New Delhi, 2017.
3. Kanti Swarup, Guptha P.K. and Man Mohan, " Operations Research, Sultan Chand & Sons, New Delhi, 2010.
4. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia, 8th Edition, 2007.

REFERENCE BOOKS:

1. John E. Freund’s Mathematical Statistics with Applications" , 8th Edition, Pearson Education, New Delhi, 2017.
2. Milton. J.S. and Arnold.J.C., “Introduction to Probability and Statistics”,Tata McGraw Hill, New Delhi, 4th Edition , 3rd Reprint , 2008.
3. Pradeep Prabhakar Pai," Operations Research and Practice",oxford University Press, New Delhi, 2012.
4. Ravindran, Philips and Solberg "Operations Research, Principles and Practice " Wiley, 2nd Edition, New Delhi 2007.
5. Frederick S Hillier and Gerald J. Lieberman, "Introduction to Operations Research Mc Graw Hill, New Delhi, 2017.

U23FTT41	FOOD CHEMISTRY AND PRESERVATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1. To understand the biochemical changes in biomolecules of food during processing and preservation; interaction among biomolecules and to explore their industrial applications

UNIT I BIO-CHEMISTRY OF COOKING 9

Chemistry of cooking-biochemical changes in carbohydrates, proteins and lipids during cooking, parboiling of rice; caramelization of sugar, browning and Millard reactions, Loss of nutrients and prevention of loss during cooking. Anti-nutritional factors and their estimation.

UNIT II BIOCHEMICAL CHANGES DURING STORAGE 9

Food storage-biochemical changes during storage of food grains, fruits and vegetables, Cold storage and freezing of foods-factors affecting quality of foods and biochemical changes

UNIT III BIOCHEMICAL CHANGES DURING FOOD PRESERVATION 9

Biochemical changes during preservation of foods; structure and mechanism of action and preservatives. Biochemical changes during processing of foods-drying, pickling, baking and malting. Biochemical changes during minimal processing of methods. Chemistry of food additives, flavor and coloring agents.

UNIT IV INDUSTRIAL APPLICATIONS OF CARBOHYDRATES 9

Isolation and purification of starch, uses of starch in food industry; pectin's and gums as stabilizers in food industry. Resistant starch. Modification of starch. Sweeteners and sugars in foods-structure activity relationship.

UNIT V PROTEINS AND ENZYMES- INDUSTRIAL APPLICATIONS 9

Isolation of protein from soybeans, milk and egg, protein hydrolysates, modification of proteins, storage and stability of proteins. Enzymatic action of post-harvest and post-mortem foods. Enzyme in food industry- amylase, glucoamylase, cellulase, polygalacturonase, protease, lipase. Enzyme immobilization

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Recognize the changes in food components during cooking, processing and Storage

CO2: Apply the different methods of food preservation

CO3: Modify the carbohydrates, proteins and fats based on its functional properties

CO4: Evaluate the safety and stability of preserved foods

CO5: Explore novel preservation techniques

CO6: Develop critical thinking and problem-solving skills

TEXT BOOKS:

1. Benjamin K. Simpson 2012. Food Biochemistry and Food Processing. Blackwell Publications UK
2. Belitz H.-D, Grosch W and Schieberle P. Food Chemistry, 4th Edition, Springer-Verlag, 2009.
3. Chopra, H.K. and P.S. Panesar. "Food Chemistry". Alpha Science International Limited,2010

REFERENCE BOOKS:

1. Geoffrey Campbell-Platt. 2009. Food science and technology. Wiley-Blackwell, UK.
2. Richard Owusu-Apenten "Introduction to Food Chemistry" CRC Press, 2005

U23FTT42	FOOD MICROBIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn basic microbial structure and growth requirements.
2. To understand the role of microbes in spoilage and pathogenesis.
3. To understand the beneficial role of microbes.
4. To gain knowledge on the methods of isolating and characterizing microbes associated with foods
5. To understand the methods used to detect pathogens in foods.

UNIT I MICROBES - STRUCTURE AND MULTIPLICATION 9

Basics of microbial existence; history of microbiology, classification and nomenclature of microorganisms, microscopic examination of microorganisms, light and electron microscopy; principles of different staining techniques like gram staining, acid fast, capsular staining, flagellar staining. Structural organization and multiplication of bacteria, viruses, algae and fungi; Nutritional requirements of bacteria; different media used for bacterial culture; growth curve and different methods to quantify bacterial growth; aerobic and anaerobic bioenergetics and utilization of energy for biosynthesis of important molecules.

UNIT II ROLE OF MICROBES IN SPOILAGE OF FOODS AND THEIR CONTROL 9

Factors affecting spoilage of foods, Microbial flora associated with various food groups their spoilage potential. Microbiological spoilage problems associated with typical food products. Use of antimicrobial chemicals- organic acids, sugars, sodium chloride, nitrites, phosphates, sulphites, Benzoates, Sorbates / Propionates naturally occurring antimicrobials; Physical methods- Low and high temperatures, drying, radiation and high pressure; Tolerance of microbes to chemical and physical methods in various foods.

UNIT III MICROBIAL AGENTS OF FOOD BORNE ILLNESS 9

Food borne infections and food poisoning, Microbial toxins - types, Gram Negative and Gram-positive food borne pathogens – Salmonella, Coliforms, E. coli, Shigella, Vibrio cholera, Staphylococcus aureus; Clostridium botulinum; Listeria monocytogenes Toxigenic algae and fungi; Food borne viruses; helminths, nematodes and protozoa.

UNIT IV MICROBIAL EXAMINATION OF FOODS 9

Detection & Enumeration of microbes in foods, Most Probable Number calculations; Indicator organisms and microbiological criteria; Rapid and automated microbial methods - development and impact on the detection of food borne pathogens; Applications of immunological, importance of clostridium botulinum techniques to food industry; Detection methods for E. coli, Staphylococci, Yersinia, Campylobacter, B. cereus, C. botulinum & Salmonella, Listeria monocytogenes, Norwalk virus, Rotavirus, Hepatitis A virus from food samples.

UNIT V FERMENTED FOODS, PRESERVATION AND SAFETY 9

Microbes of importance in food fermentations. Microbes associated with typical food fermentations-yoghurt, cheese, fermented milks, breads, idly, soy products, fermented vegetables and meats. Food preservation, principles, factors affecting preservation, Food sanitation, indicators of food safety, coliform bacteria, food processing sanitation, microbiological standards and guidelines, HACCP, microbial quality control and food laws.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Classify the microorganism and identify the microorganism associated with foods

CO2: Analyse the microorganism responsible for spoilage of foods and its assessments

CO3: Assess the cause for food borne illness

CO4: Apply the learnt techniques to detect the pathogens associated with the foods

CO5: Analyse the fermented products, its preservation methods to control the spoilage and understand the quality control for safety of food

CO6: Classify the microorganism and identify the microorganism associated with foods

TEXT BOOKS:

1. Pelczar M.J., Chan E.C.S. and Krieg N.R., ―Microbiology‖, 5th Edition, Tata McGraw Hill, New York, 2004
2. Frazier W.C., Westhoff D.C. and Vanitha N.M., ―Food Microbiology‖, 5th Edition, Tata McGraw Hill, New Delhi, 2014
3. James M. Jay, Martin J. Loessner, David A. Golden, ―Modern Food Microbiology‖, 7th Edition, Springer, Boston, MA, USA, 2005.

REFERENCE BOOKS:

1. Pawsey, R.K. "Case Studies in Food Microbiology for Food Safety and Quality". The Royal Society of Chemistry, 2001.
2. Forsythe, S.J. "The Microbiology of Safe Food". Blackwell Science, 2000.

U23FTT43 PROPERTIES OF FOOD MATERIALS

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn about the physical properties of food materials.
2. To know about the thermal properties- definition, principle and its applications
3. To understand the optical properties and electrical properties of detect the food materials.
4 To study about the rheological properties and textural properties – principle, types and its applications.
5 To understand the textural properties and colours of the food materials.

UNIT I PHYSICAL PROPERTIES **9**

Physical Properties: Physical properties of food materials- size, shape, density, porosity and surface area – definitions and measurements, moisture content and its determination, direct and indirect methods, units, Frictional properties – friction – types, coefficient of friction, angle of repose – types and its determination.

UNIT II THERMAL PROPERTIES **9**

Thermal Properties: Thermal properties, Definition of specific heat, enthalpy, conductivity and diffusivity, surface heat transfer coefficient. Measurement of specific heat, thermal conductivity, thermal diffusivity. Cryogenics, Calorific value of food, Bomb calorimeter. Applications of thermal properties.

UNIT III OPTICAL PROPERTIES **9**

Optical Properties: Refractive index of food items, Abbes refractometer, Sorting of food material using optical properties, Optical activity, Polarimeter, Spectrophotometer, Gloss, color, translucency — Definitions, measurement and applications. Electromagnetic Properties: Electrical properties, dielectric heating, electrical conductivity, dielectric measurements, microwave heating and other Applications.

UNIT IV RHEOLOGICAL PROPERTIES **9**

Rheological Properties: Stress Strain behaviour of Newtonian and Non- Newtonian fluids- Bingham and Non-Bingham. Stress-strain relationships in solids, liquids and viscoelastic behaviour- stress relaxation test, creep test and dynamic test, stress-strain diagrams, Emulsions and Colloids. Viscosity– Principle, Types- Capillary, Orifice, Falling and Rotational viscometers.

UNIT V TEXTURAL PROPERTIES **9**

Textural Properties: Types of food textures, Texture measuring instruments- Compression, Snap Bending, Cutting Shear, Puncture, Penetration and TPA, Properties of food powders. Colour: Interaction of object with light, Colorimeter- Color order systems- Munselcolor system, CIE color system, Hunter lab color space, Loviebond system.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Interpret the physical properties of agricultural materials
CO2: Elaborate the thermal properties and its application
CO3: Outline the optical and electromagnetic properties
CO4: Recognize the rheological properties of food materials
CO5: Infer textural properties and color measurements of food materials
CO6: Interpret the Properties of food powders

TEXT BOOKS:

1. Toledo, Romeo T. "Fundamentals of Food Process Engineering" II Edition. CBS Publishers, 2000.
2. Rha, C. K. (Ed.). (2012). Theory, determination and control of physical properties of food materials (Vol. 1). Springer Science & Business Media.
3. Sahin, S., & Sumnu, S. G. (2006). Physical properties of foods. Springer Science & Business Media.

REFERENCE BOOKS:

1. Stroshine R., ―Physical Properties of Agricultural Materials and Food Products‖, West Lafayette, IN., Purdue University, 2004.
2. Singh R. Paul and Heldman Dennis R., ―Introduction to Food Engineering‖, 3rd Edition, GulfPublishing USA, 5th Edition 2014.

U23FTT35	THERMODYNAMICS IN FOOD INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for

1. To introduce fundamental thermodynamic principles and their application.
2. To understand the second law of thermodynamics- principles and its applications
3. To get conversant with properties of steam, thermodynamic vapour cycles, and performance Estimation
4. To learn the phase equilibrium and chemical reaction equilibrium in food processing
5. To study the microbial thermo kinetics.

UNIT I BASIC CONCEPTS AND FIRST LAW **9**

Fundamental concepts of thermodynamics- microscopic and macroscopic approach – systems, properties, process, functions, units, energy, heat and work, zeroth law. First law - statement of first law for flow and non - flow process, internal energy, enthalpy, heat capacities (CV and CP)

UNIT II SECOND LAW OF THERMODYNAMICS **9**

Second Law of thermodynamics: Kelvin-Plank, Clausius statements and its equivalence, reversible cycle – Carnot cycle and theorem – thermodynamic temperature scale. Entropy, Clausius theorem, Clausius inequality, Entropy changes during processes – available and unavailable energies.

UNIT III PROPERTIES OF PURE SUBSTANCE AND STEAM POWER CYCLE **9**

Formation of steam and its thermodynamic properties, p-v, p-T, T-v, T-s, h-s diagrams. p-v-T surface. Use of Steam Table and Mollier Chart. Determination of dryness fraction. Application of I and II law for pure substances. Ideal and actual Rankine cycles, Cycle Improvement Methods - Reheat and Regenerative cycles, Economiser, preheater, Binary and Combined cycles. Application of steam in food process industries.

UNIT IV PHASE EQUILIBRIA AND CHEMICAL REACTION EQUILIBRIA **9**

Criteria for phase equilibria; VLE calculations for binary and multi component systems; liquid-liquid equilibria and solid-solid equilibria. Equilibrium criteria for homogeneous chemical reactions; evaluation of equilibrium constant; effect of temperature and pressure on equilibrium constant; calculation of equilibrium conversion and yields for single and multiple reactions.

UNIT V THERMODYNAMIC ANALYSIS OF PROCESSES **9**

Concept of lost work; entropy generation; calculation of real irreversible process; power cycle; liquefaction. Applications of laws of thermodynamics; Refrigeration, steam power plant, flow process

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1 Outline the basic concepts and apply the first law of thermodynamics in selected Processes

CO2 Understand the principle of second law of thermodynamics

CO3 Interpret the second law of thermodynamics and relate the properties of pure substance

CO4 Demonstrate the interrelationship between thermodynamic cycles
CO5 Integrate the use of thermodynamics in product formation
CO6 Explain the Thermodynamics of microbial growth stoichiometry

TEXT BOOKS:

1. Narayanan K.V., ―A Text Book of Chemical Engineering Thermodynamic‖, Prentice Hall of India, New Delhi, 2003
2. Food Process Engineering: Principles and Applications by R. Paul Singh and Dennis R. Heldman
3. E. Rathakrishnan, "Fundamentals of Engineering Thermodynamics", 2nd Edition, Prentice Hall of India Pvt. Ltd, 2006

REFERENCE BOOKS:

1. Ballaney P.L., ―Thermal Engineering‖, 23rd Edition, Khanna Publishers, New Delhi, 2005
2. Smith J.M., Van Ness H.C. and Abbott M.M., ―Introduction to Chemical Engineering Thermodynamics‖, 7th Edition, McGraw Hill, New York, 2005.
3. Rao Y.V.C., ―An Introduction to Thermodynamics‖, Universities Press, 2004.

U23GET61	HUMAN VALUES AND ETHICS	L	T	P	C
		3	0	0	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Teach definition and classification of values.
2. Explain Purusartha.
3. Describe Sarvodaya idea.
4 Summarize sustenance of life.
5 Conclude views of hierarchy of values.

UNIT I **DEFINITION AND CLASSIFICATION OF VALUES** **9**

Extrinsic values- Universal and Situational values- Physical- Environmental-Sensuous- Economic Social-Aesthetic-Moral and Religious values.

UNIT II **CONCEPTS RELATED TO VALUES** **9**

Purusartha-Virtue- Right- duty- justice- Equality- Love and Good.

UNIT III **IDEOLOGY OF SARVODAYA** **9**

Egoism- Altruism and universalism- The Ideal of Sarvodaya and Vasudhaiva Kutumbakam

UNIT IV **SUSTENANCE OF LIFE** **9**

The Problem of Sustenance of value in the process of Social, Political and Technological Changes.

UNIT V **VIEWS ON HIERARCHY OF VALUES** **9**

The Problem of hierarchy of values and their choice, The views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand definition and classification of values.
CO2: Understand purusartha.
CO3: Understand sarvodaya idea.
CO4: Understand sustenance of life.
CO5: Understand the hierarchy of values.
CO6: Compare hierarchial views of Pt. Madan Mohan Malviya and Mahatma Gandhi.

TEXT BOOKS:

1. Awadesh Pradhan : Mahamanake Vichara. (B.H.U., Vanarasi-2007)
2. Little, William, : An Introduction of Ethics (Allied Publisher, Indian Reprint 1955)

REFERENCE BOOKS:

1. William, K Frankena : Ethics (Prentice Hall of India, 1988)

U23FTP41	FOOD CHEMISTRY AND PRESERVATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the basic principles involved in food process engineering
2. To apply the concept of mass and energy balances during processing of food
3. To perform calculations on unit operations involved in food Processing

LIST OF EXPERIMENTS

1. Determination of textural characteristics of foods
2. Determination of Thermal Death Time
3. Determination of Water activity of processed food products
4. Determination of drying rate of fruits and vegetables in Tray dryer
5. Determination of colour characteristics of curry leaves during Fluidized bed dryer
6. Determination of textural characteristics by Extrusion cooking
7. Retention of ascorbic acid during drying of leafy vegetable
8. Osmotic drying of foods with salt and sugar
9. Study the freezing point of food materials
10. Spray drying of juices/milk
11. Effect of UV treatment on microbial quality of liquid foods
12. Visit to food processing industries/ pilot plant

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Tray dryer	1
2.	Texture analyzer	1
3.	UV spectrophotometer	1
4.	Color comparator	1
5.	Water bath	2
6.	Refractometer	2
7.	Moisture analyzer	1
8.	Refrigerator	
9.	Deep freezer	1
10.	Extruder	1

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Assess the moisture content and drying rate for both porous and non-porous food Materials

CO2: Evaluate the efficiency of different types dryers for the food materials

CO3: Analyze the changes occur during thermal processing of foods
CO4: Assess the microbial quality of foods by applying novel processing methods
CO5: Investigate chemical reactions in Chemical preservation
CO6: Apply food chemistry techniques in preservation problem-solving

U23FTP42	FOOD MICROBIOLOGY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the types of media to grow the microorganisms.
2. To understand and use various microbiological techniques for the study of foods.
3. To understand the methods used to detect pathogens in foods.
4. To understand the methods used to detect pathogens in foods.
5. To understand the effect of cleaning and disinfection on microbial load

LIST OF EXPERIMENTS

1. Introduction, Laboratory Safety, Use of Equipment; Sterilization Techniques; Culture Media Types and Use; Preparation of Nutrient broth and agar
2. Culture Techniques, Isolation and Preservation of Cultures- Broth: flask, test tubes; Solid: Pour plates, streak plates, slants, stabs
3. Microscopy – Working and care of Microscope; Microscopic Methods in the Study of Microorganisms; Staining Techniques- Simple, Differential- Gram‘s Staining
4. Quantification of Microbes: Sampling and Serial Dilution; Bacterial count in food products TVC
5. Microbiological Quality of Water (MPN)
6. Microbiological quality of milk
7. Enumeration of Lactic acid bacteria from fermented foods
8. Yeast & Mold count from fruits
9. Enumeration of spores from pepper
10. Inhibitory effect of spices on microbial load in fish & flesh foods
11. Enumeration & Isolation of E. coli from processed meat/chicken
12. Effect of cleaning and disinfection on microbial load

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Laminar Air Flow Chamber	2
2.	Hot Air Oven	2
3.	Autoclave	1
4.	Refrigerator	1
5.	Analytical Weighing balance	2
6.	Homogenizer	1
7.	pH Meter	2
8.	Shaking Incubator	2
9.	Quebec Colony counter	1
10.	Magnetic stirrer	2
11.	Vortex mixer	2
12.	Light Microscope	2
13.	Static Incubator	1
13.	Glassware / Chemicals	As required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Complete understanding of isolation and characterization of various microbes associated with foods

CO2: Familiarize with microbial techniques for study of foods.

CO3: Methods for quantification of Microbes.

CO3: To analyse and identify microbial contamination in food

CO4: To analyze the microbiological quality

CO5: Enumerate the spores in food materials.

CO6: To analyze the disinfection techniques.

U23HSP41	COMMUNICATION SKILLS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the academic studies with primary emphasis on academic speaking and listening skills.
2. To Provide guidance and practice in basic general and classroom conversation and to engaging specific academic speaking activities.
3. To Improve general and academic listening skills
4. To Make effective presentations

LIST OF EXPERIMENTS

1. Listening as a key skill- its importance- speaking - give personal information - ask for personal information - express ability - enquire about ability - ask for clarification Improving pronunciation - pronunciation basics taking lecture notes - preparing to listen to a lecture -articulate a complete idea as opposed to producing fragmented utterances.
2. Listen to a process information- give information, as part of a simple explanation - conversation starters: small talk - stressing syllables and speaking clearly - intonation patterns - compare and contrast information and ideas from multiple sources- converse with reasonable accuracy over a wide range of everyday topics.
3. Lexical chunking for accuracy and fluency- factors influence fluency, deliver a five-minute informal talk - greet - respond to greetings - describe health and symptoms - invite and offer - accept –decline - take leave - listen for and follow the gist- listen for detail
4. Being an active listener: giving verbal and non-verbal feedback - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations -persuade.
5. Conversational skills (formal and informal)- group discussion- making effective presentations using computers, listening/watching interviews conversations, documentaries. Listening to lectures, discussions from TV/ Radio/ Podcast.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Listen and respond appropriately.
CO2: Listen to a process information
CO3: Assess the accuracy and fluency in talking
CO4: Participate in group discussions
CO5: Summarizing academic readings
CO6: Making effective presentations

SEMESTER V

		L	T	P	C
U23FTT51	**FOOD ANALYSIS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To expose the students to the principles, methods and techniques of chemical and instrumental methods of food analysis.
2. To understand the principles behind analytical techniques in food analysis
3. To know the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries
4 To learn and study about the chromatographic techniques-HPLC,GC
5 To familiarize with the current state of knowledge in food analysis

UNIT I INTRODUCTION 9

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

UNIT II LIPIDS, PROTEINS AND CARBOHYDRATE ANALYSIS 9

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 SPECTROSCOPIC TECHNIQUES 9

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 and ICP-AES in analysis of mineral elements and fluorimeter in vitamin analysis

UNIT IV CHROMATOGRAPHIC TECHNIQUES 9

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 ELECTROPHORESIS, REFRACTOMETRY AND POLARIMETRY 9

Basic principles; application of the electrophoresis in food analysis; Brix 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.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the principles behind analytical techniques in food analysis.
CO2: Explain the methods of selecting appropriate techniques in the analysis of food products.
CO3: Explain the role of food analysis in food standards and regulations for the manufacture and the sale of food products and food quality control in food industries
CO4: Demonstrate about the chromatographic techniques-HPLC,GC
CO5: Apply the current state of knowledge in food analysis
CO6: Apply Good laboratory practises and quality assurance

TEXT BOOKS:

1. Pomeranz, Yeshajahu. ―Food Analysis: Theory and Practice‖. 3rd Edition. Aspen Publishers /Springer, 2000.
2. Kirk, R.S. and R. Sawyer ―Pearson‘s Composition and Analysis of Food‖. 9th Edition. Longman, New York, 1991
3 Nielsen, S. Suzanne. ―Food Analysis‖. 5thEdition. Springer, 2019.

U23FTT52	HEAT AND MASS TRANSFER IN FOOD PROCESSES	L	T	P	C
		3	1	0	4

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn the principles and applications of heat and mass transfer operations in food industries.
2. To understand the mechanisms and concept of heat transfer effectively.
3. To Investigate the mass transfer operational approaches.
4. To interpret mass transfer operations in food processing.
5. To interpret Unit operations in food processing.

UNIT I HEAT TRANSFER – CONDUCTION **12**

Basic heat transfer processes - conductors and insulators - conduction – Fourier's law of heat conduction – thermal conductivity and thermal resistance - linear heat flow – heat transfer through homogenous wall, composite walls, radial heat flow through cylinders and sphere – solving problems in heat transfer by conduction.

UNIT II HEAT TRANSFER – CONVECTION **12**

Heat transfer - convection – free and forced convection - factors affecting the heat transfer coefficient in free and forced convection heat transfer – overall heat transfer coefficient - solving problems in foods.

UNIT III HEAT TRANSFER – RADIATION AND HEAT EXCHANGER **12**

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 MASS TRANSFER - DIFFUSION, EVAPORATION AND CONCENTRATION **12**

Unit operations in food processing –conservation of mass and energy – overall view of an engineering process-dimensions and units – dimensional and unit consistency – dimensionless ratios-evaporation – definition – liquid characteristics – single and multiple effect evaporation-performance of evaporators and boiling point elevation – capacity – economy and heat balance-types of evaporators – once through and circulation evaporators – short tube evaporators and long tube evaporators – agitated film evaporator.

Mass transfer in foods – introduction – Fick's law for molecular diffusion - molecular diffusion in gases – equimolar counters diffusion in gases and diffusion of A through non diffusing B, diffusion coefficients for gases - molecular diffusion in liquids, solids, biological solutions and gels.

UNIT V MASS TRANSFER – DISTILLATION **12**

Vapour liquid equilibria - Raoult's law- Principle of distillation - flash distillation, differential distillation, steam distillation, multistage continuous rectification, Number of ideal stages by Mc. Cabe -Thiele method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply the basic concepts of heat flow.

CO2: Assess the mode of heat transfer.
CO3: Discuss the radiation mode of heat transfer.
CO4: Interpret mass transfer operations in food processing.
CO5: Interpret Unit operations in food processing
CO6: Elaborate distillation operations.

TEXT BOOKS:

1. Bellaney, P.L. "Thermal Engineering". Khanna Publishers, New Delhi, 2001.
2. Gangawane, K. M., & Dwivedi, M. (Eds.). (2022). Advanced Computational Techniques for Heat and Mass Transfer in Food Processing. CRC Press.

REFERENCE BOOKS:

1. Coulson, J.M. and et al. "Coulson & Richardson's Chemical Engineering", 6th Edition,Vol.I & II, Butterworth – Heinman (an imprint of Elsevier), 2004.
2. McCabe, W.L., J.C. Smith and P.Harriot "Unit Operations of Chemical Engineering",6th Edition, McGraw Hill, 2003.

U23FTP51	FOOD ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To study the foods and food products for chemical components, compliance to standards; detection of adulterants in foods.

LIST OF EXPERIMENTS

1. Determination of moisture in spices powder by distillation method and Hot air oven method.
2. Determination of total fat and protein in solid samples
3. Rancidity test for fried foods to assess primary and secondary oxidative products
4. Determination of Vitamin C in fruit juices.
5. Estimation of synthetic Food colour in sweets, confectioneries and beverages.
6. Determination of Iodine content in iodized salt.
7. Detection of anti - oxidant in foods
8. Determination of soluble and insoluble fibre in foods.
9. Determination of total fat and protein in liquid samples
10. Column chromatographic separation of colours
11. The identification of sugars in fruit juice using TLC.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Soxhlet apparatus	2
2.	Kjeldahl apparatus	2
3.	UV spectrophotometer	1
4.	Colour comparator	1
5.	Water bath	2
6.	pH meter	2
7.	Weighing balance	1
8.	Hot air oven	2
9.	Simple distillation unit	1
10.	TLC paper strips as required Glassware / Chemicals	As required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Analyze the foods and food products for chemical components. Knowing standards for foodproducts

CO2: Obtain knowledge of adulterants in foods.

CO3: Familiarize with instrumental analysis techniques

CO4: Develop skills in method validation and quality control

CO5: Communicate Scientific findings effectively

CO6: Collaborate effectively in laboratory setting

U23FTP52	HEAT AND MASS TRANSFER IN FOOD PROCESSES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To develop a sound working knowledge on different types of heat transfer equipments.
2. To determine diffusivity and Stefan Boltzman constant using fundamental principles
3. To understand and apply the principles in heat transfer phenomena
4. To understand and apply the principles in mass transfer phenomena
5. To design heat and mass transfer equipments.

LIST OF EXPERIMENTS

1. Heat transfer in natural convection/ forced convection
2. Determination of Stefan Boltzman constant
3. Estimation of thermal conductivity of a material
4. Overall coefficient of heat transfer in shell and tube heat exchanger.
5. Heat transfer in an agitated vessel
6. Heat transfer in bare and fin tubes
7. Verifying the Raleigh_s equation for the given system using simple distillation setup
8. Determination of vaporization efficiency (Ev) and thermal efficiency (Et) of the given system using steam distillation setup
9. Determination of the diffusivity of given liquid to air
10. Determination of the activity coefficients by vapor liquid equilibrium

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Natural/forced convection setup	1
2.	Stefan Boltzman constant setup	1
3.	Differential scanning calorimeter	1
4.	Shell and tube heat exchanger	1
5.	Agitated vessel	1
6.	Bare and fin tubes	1
7.	Simple distillation setup	1
8.	Steam distillation setup	1
9.	Glassware / Chemicals	As required

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Evaluate the process/performance parameters for mass transfer operations
CO2: Determine diffusivity and Stefan Boltzman constant using fundamental principles
CO3: Understand and apply the principles in heat transfer phenomena
CO4: Understand and apply the principles in mass transfer phenomena
CO5: Design heat and mass transfer equipments.
CO6: Determine the diffusivity of air.

SEMESTER VI

		L	T	P	C
U23FTT61	**REFRIGERATION AND COLD CHAIN MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn about the Basic understanding about engineering materials, pumps, heat Exchangers
2. To study about the Knowledge about principles of thermodynamics, refrigeration.
3. To design the cold storage systems for food products
4. To know about the cold chain and role of refrigeration in food production

UNIT I INTRODUCTION **9**

Introduction: Introduction to refrigeration, unit of refrigeration capacity. Review of Second law of thermodynamics and interpretation. Production of low temperatures - principles and process. Refrigerants - classification and thermodynamic properties. Ozone depletion potential. Reversed Carnot cycle. Limitations of reversed Carnot systems.

UNIT II REFRIGERATION SYSTEMS **9**

Refrigeration Systems: Refrigeration cycle – simple vapour compression, vapour absorption cycle, p-h and T-s diagrams, COP. Energy ratios and Power consumption of a refrigerating machine. Standard rating cycle and effect of operating conditions. Air refrigeration system – reversed Brayton cycle.

UNIT III COMPONENTS OF A REFRIGERATION SYSTEM **9**

Components of A Refrigeration System: Evaporator- dry and flooded type, liquid cooling evaporator. Condenser- water cooled, air cooled and evaporative condenser. Compressor - Reciprocating type compressors. Expansion valve - thermostatic expansion valve.

UNIT IV LOW TEMPERATURE STORAGE **9**

Low Temperature Storage Systems: Pre-cooling systems, Cold storage- construction, insulation and operation. Design of cold storage unit. Calculation of refrigeration load in cold store. Prefabricated systems, walk-in-coolers. Frozen storage, Cryogenics – Linde and Claude system for liquefaction of air

UNIT V COLD CHAIN **9**

Cold Chain: Introduction, Components of cold chain. Refrigerated distribution and transport systems, Cold chain in retail, Traceability- Application of RFID in cold chain. Role of refrigeration in food production - candy manufacture, beverage processing, bakery products, meat products, poultry products, fishery products, fruit /vegetables and dairy products

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1:	Interpret the basics of refrigeration with thermodynamic principles and Carnot Cycle
CO2:	Make use of the concept of refrigeration cycles
CO3:	Identify various components of refrigeration system and its types
CO4:	Adapt low temperature storage systems for foods
CO5:	Apply cold chain for food products
CO6:	Apply refrigeration for food products

TEXT BOOKS:

1. Rajput R.K., ―Refrigeration and Air-conditioning‖, 3rd Edition, S.K. Kataria and Sons (Publishers), Delhi,2012.
2. Dellino C.V.J., ―Cold and Chilled Storage Technology‖, 2nd Edition, Springer, US, 2011.

REFERENCE BOOKS:

1. Arora C.P., ―Refrigeration and Air Conditioning‖,3rd Edition, Tata McGraw-Hill Publishing Company Ltd., Delhi, 2013.
2. Khurmi R.S. and Gupta J.K., ―Textbook of Refrigeration and Air Conditioning‖, 5th Edition, S. Chand Publishers, New Delhi, 2018.

U23FTT62	FOOD PROCESS ENGINEERING	L	T	P	C
		3	1	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand basic engineering properties of food.
2. To recognize different thermal and non-thermal processes used in Food Industry.

UNIT I PROPERTIES OF FOOD **9**

Engineering properties of food materials - Rheological and textural Properties, Thermal Properties, Thermodynamic Properties, surface and gas exchange properties, electric and dielectric properties Water activity and states a thermodynamic quantity, water sorption isotherms, hysteresis, theories of sorption hysteresis, water activity measurement methods, water binding, control of water activity and moisture, principles of IMF and their application

UNIT II SEDIMENTATION AND CENTRIFUGATION **9**

The velocity of particles moving in a fluid - terminal velocity - drag coefficient terminal velocity magnitude, Sedimentation - sedimentation equipment, Floatation, Sedimentation of Particles in a Gas Settling Under Combined Forces Cyclones- optimum shape, efficiency Impingement, separators Classifiers, Centrifugal separations - centrifugal force particle velocity Liquid Separation radial variation of pressure radius of neutral zone Centrifuge Equipment

UNIT III DRYING AND FREEZING **9**

Basic Drying Theory - Three States of Water phase diagram for water, Heat Requirements for Vaporization, Thermodynamics of moist air (psychrometry) - Measurement of Humidity, Air Drying, Conduction Drying, Drying under varying external condition, methods of drying, Drying Equipment, Dryer Efficiencies, calculation of drying time, Concept of Osmotic dehydration, Factors influencing osmosis. Freezing -Freezing curve for Homogenous and Non-homogenous food system, Freezing point depression, Freezing rate, Effect of freezing Physical and chemical changes in Foods, Enzyme activity, Microbe inactivation and Food quality sensory quality, nutritional aspects, freeze drying and freeze concentration

UNIT IV THERMAL PROCESSING **9**

Principles of Thermal Processing, Heat Transfer in Thermal Processing, Characterization of Heat Penetration Data, Retort Come-Up Time, kinetics of thermal inactivation of microorganisms and enzymes, Concept of thermo bacteriology Temperature Dependence Reaction Rates, Processes and Systems for Stabilization of Foods for Shelf-Stable Storage, Heat transfer considerations in thermal processing - In-package, In-Flow

UNIT V FOOD MATERIAL PROCESSING **9**

Membrane processes Ultra filtration, Reverse osmosis, Electrodialysis, per-evaporation and micro filtration – principles - application in food industry, Extrusion - Extrusion cookers - cold extrusion, single and twin-screw extrusion - Low pressure and high-pressure extrusion - properties of Food materials and its significance in equipment design - processing and handling application in food industry; Baking Principles, baked foods, baking equipment; Roasting Principles of roasting, roasting equipment

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Apply the knowledge of physical properties of foods during the processing.

CO2: Evaluate time temperature required to achieve desired shelf life of foods

CO3: Explain the principles and current practices of mixing and the effects of processing parameters on product quality.

CO4: Interpret the encapsulation technology available in the field of processing

CO5: Develop novel products using extrusion cooking
CO6: Understand the environmental impact of Food processing

TEXT BOOKS:

1. Toledo, Romeo T. "Fundamentals of Food Process Engineering" II Edition. CBS Publishers, 2000.
2. Fellows, P J. "Food Processing Technology Principles and Practice". 3rd Edition, Woodhead, 2009.
3. Smith P. G "Introduction to Food Process Engineering". Springer, 2005
4. Earle, R.L, "Unit Operations in Food Processing". Pergamon Press. Oxford. U.K, 2013.

REFERENCE BOOKS:

1. Sahay, K. M. and K. K. Singh. "Unit operation of Agricultural Processing", Vikas Publishing House Pvt. Ltd., New Delhi, 2004.
2. Berk, Zeki. "Food Process Engineering and Technology". Elsevier, 2009.

U23FTP61	FOOD PROCESS ENGINEERING LABORATORY	L	T	P	C
		0	0	4	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Analyse applications of heat and mass transfer principles.
2. Enable students to develop models for optimization of process conditions for different food application

LIST OF EXPERIMENTS

1. Material Testing and Rheology of Solid Foods.
2. Rheology of Liquid and Semisolid Foods.
3. Concepts of Heat Transfer and Thermal Death Times.
4. Canning, Retort Thermal Processing, and Lethality Computation by General Method.
5. Heat Penetration Test and Thermal Process Design Using Ball's Formula Method.
6. Blanching and Freezing of Foods.
7. Ultra-High-Temperature Processing.
8. Membrane Processing of Liquid Foods.
9. Evaporation Concentration of Liquid Foods.
10. Spray, Drum Drying, Convective Drying of Foods.
11. Osmotic Dehydration of Foods.
12. Microwave Heating of Foods.
13. Frying & Extrusion Cooking of Foods.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S No	Name of the Equipment	Quantity
1.	Spray drier	1
2.	Hot air oven	1
3.	Tray drier	1
4.	Microwave oven	1
5.	Canning unit	1
6.	Extruder	1
7.	Viscometer	1
8.	Deep freezer	1
9.	Texture analyzer	1

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand heat, mass and momentum transfer analysis.
CO2: Validation of a thermal process
CO3: Analyze industrial problems along with appropriate approximations and boundary Conditions
CO4: Interpret the encapsulation technology available in the field of processing.
CO5: Develop novel products using extrusion cooking.
CO6: Understand heat, mass transfer analysis.

U23FTP62	BAKING AND CONFECTIONERY TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	1.5

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. To provide insight practical knowledge about the different raw materials and products of bakery and confectionery sectors.

LIST OF EXPERIMENTS

1. Estimation of quality parameters of bakery ingredients
2. Estimation of wet and dry gluten content of wheat flour.
3. Determination of dough rising capacity of yeast..
4. Preparation and analysis of cookies..
5. Estimation of water absorption power, alkaline water retention and sedimentation value of flour.
6. Preparation and analysis of bread.
7. Preparation and analysis of biscuits and cookies..
8. Preparation and analysis of cake..
9. Preparation of sugar boiled confectionery.
10. Preparation of toffee and fudge
11. Preparation of cocoa based confectionery..
12. Virtual Lab: Demonstration on Yeast Fermentation

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

S No	Name of the Equipment	Quantity
1.	Hot air oven	1
2.	Tray drier	1
3.	Microwave oven	1
4.	Dough mixing equipment	1
5.	Extruder	1
6.	Viscometer	1
7.	Colorimeter	1
8.	Texture analyzer	1

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Analyze the quality of flour and other ingredients used for preparation of bakery products

CO2: Prepare the bakery product and evaluate its properties

CO3: Formulate confectionery products and perform sensory properties

U23FTP63	VILLAGE ADOPTION	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To train the students in field work by attaching to any industry / organization so as to have a first-hand knowledge of practical problems in Food Technology.
2. To gain working experience and skills in carrying out technological tasks related to various fields of Food technology.

It is conceptualized to Food technologists for ensuring and assuring employability and to develop entrepreneurs for emerging knowledge intensively on food by articulating knowledge, skill, ability and experiences. The students individually undertake training in reputed engineering companies / Govt organisations / NGOs / Educational Institutions/ accumulate nearby village or rural areas or Food industries, who work in the area of Food Technology for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

No. of. days: 20 to 25

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1:	Understand village life at grass root level according to food processing
CO2:	Reach the farmers and uplifting them to mainstream with help of food processing
CO3:	Study the farmers need and find out the solution
CO4:	Analyse community needs on development in the application of Food technology Techniques
CO5:	Enhance intercultural competency and adaptability
CO6:	Reflect and learn from the village adoption experience

U23FTP64	INDUSTRIAL TRAINING/INTERNSHIP - I	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Get practical knowledge on production process in the industry and develop skills to solve related problems
2. Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within ten days from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of. days: 15

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Analysis of industrial / research problems and their solutions

CO2: Documenting of material specifications, machine and process parameters, testing parameters and results

CO3: Preparing of Technical report and presentation

CO4: Acquire an understanding of the workplace norms, Etiquette and professionalism

CO5: Identify strengths, weaknesses and areas for improvement

CO6: Understand industry's structure, trends and challenges

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SEMESTER VII

		T	P	C
U23FTT71	**FOOD PLANT LAYOUT AND ECONOMICS**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the processes involved in layout design
2. To enable the students understand various concepts of economics of food plant
3. To understand the development and design consideration and cost estimation in food industry.
4. To understand the cost in designing food plant layout
5. To understand the methods for determining profitability

UNIT I FOOD PROCESS DESIGN DEVELOPMENT 9

Feasibility studies and its importance. Technical feasibility survey of Food Industry, process development, Food Process flow sheets Product and Process flow diagram- Representative examples—Computed-aided process design – Principles of spread-sheet aided process design
(Basic concepts only)

UNIT II PLANT LAYOUT 9

Criteria for selection of site, process and product Government regulations and other legal restrictions, community factors and other factors affecting investment and production costs. Plant Layout based on process and product. Richard Muther's Simple Systematic Plant Layout. Layout design for representative product industries – Hazard and its prevention- OSHA guidelines

UNIT III OVERVIEW OF HYGIENIC DESIGN LAYOUT AND PROJECT COST ESTIMATION 9

Hygienic food process design – Principles of Sanitary design - equipment design and specifications Basic outline on FSMS. Capital investments – fixed capital investments including land, building, equipments and utilities, installation costs (including equipments, instrumentation,
piping, electrical installation and other utilities), working capital investments. Methods of cost estimation – Cost Indices.

UNIT IV PRODUCT COST AND PLANT OVERHEADS 9

Manufacturing costs – Direct production costs(including raw materials, human resources, maintenance and repair, operating supplies, power and other utilities, royalties, etc.). – Process Profitability - Application to a Food Processing plant. Depreciation, Amortization and methods of
determining the same. – Energy audit concept

UNIT V PROFITABILITY ANALYSIS 9

Methods to determine profitability - Cash flow diagram and its importance - Optimization techniques – Linear and Dynamics programming, Optimization strategies. Overview of the concepts of Total quality management

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO1:** Gain knowledge on the various factors involved in setting up a Food Processing Industry.
- **CO2:** Understand the process of food plant layout design.
- **CO3:** Apply their knowledge to design projects for setting up a Food Processing Industry.
- **CO4:** Analyse the problems involved in deciding the level of manufacture of a food product
- **CO5:** Evaluation of the options involved in the system
- **CO6:** Decision on the right choice based on the economics of the system

TEXT BOOKS:

1 Max S. Peters, Klaus D. Timmerhaus, Ronald E. West. "Plant design and Economics for Chemical Engineers, 5th Edition, McGraw Hill, ISBN -125900211X, 781259002113, 2011.

2 Towler G and Sinnott R.K. "Chemical Engineering design principles, practice and Economics of Plant and Process", 2nd Edition. Elsevier, ISBN-9780080966595, 2012

3 Rudd D F and Watson C C, "Strategy of Process Engineering", John Wiley & Sons Inc, ISBN- 978-0471844559, 2013.

4 Heldman D.R. and Lund D B. "Hand Book of Food Engineering", 2nd edition, CRC Press, Taylor and Francis Group, ISBN-10: 1466563125, ISBN-13: 978-1466563124, 2019

REFERENCE BOOKS:

1 Antonio Lopez Gomez, Gustavo V. Barbosa -Canovas, " Food Plant Design" 1st edition, CRC Press, Taylor and Francis Group, ISBN- 9780429118944, 2005

2 Zacharias B. Maroulis, George D. Saravacos, "Food Plant Economics" CRC Press, Taylor and Francis Group, ISBN- 9781420005790, 2017

U23FTT72	DAIRY TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the principle and significance of various processing methods (both thermal and emerging non-thermal) of market milk and milk product in dairy plant
2. To study about the dairy products analysis, sanitation and hygiene requirements.
3. To identify and in-depth knowledge of the designing equipment, cleaning and sanitization of dairy equipment

UNIT I PHYSICAL CHEMISTRY, COLLECTION AND PRE- PROCESSING OF RAW MILK **9**

Milk - Definition, Types of market milk, Composition of milk, Factors affecting composition, Properties of milk: Colour, Flavour, Specific Gravity, Boiling point, Freezing point, Acidity and pH, Viscosity. Practices for collection of raw milk, Raw milk shelf-life extension systems, Cooling and transportation of raw milk, Platform tests of raw milk, Reception of raw milk, Filtration and Clarification of raw milk, Bactofugation of raw milk, Cooling and storage of raw milk

UNIT II PROCESSING AND QUALITY PARAMETERS OF MILK **9**

Processing of Milk- Pasteurization-HTST, UHT, sterilization, Homogenization, Filtering and Clarification of Milk-cream separation-Methods and Equipment's-Emulsification – Fortification, packaging of milk and milk products, judging and grading of milk, national and international standards of milk and milk products.

UNIT III MANUFACTURING OF DIFFERENT TYPES OF MILK **9**

Concentrated and dried milk products- Basic technology of concentration and drying. Manufacture of concentrated milk - bulk condensed milk, canned evaporated milk and sweetened condensed milk. Manufacture of skim milk powder and whole milk powder. Physico-chemical properties of concentrated and dried milks. Changes affecting the quality of concentrated and dried milks. Microbiology of concentrated and dried milk products. Nutritive value of concentrated and dried milk products.

UNIT IV MILK PRODUCTS **9**

Manufacturing of Yogurt, Cheese, Butter, Ghee, Ice-cream, malted products, Traditional dairy products, evaporated milk products - properties, Classification-processing Methods, Equipment used, standards and quality parameters, Dairy By-products: Definition, Types. Caseinates: Composition, Process of manufacture, Whey Protein products: Classification, Process of manufacture

UNIT V STORAGE SANITATION AND EFFLUENT TREATMENT **9**

Storage of Milk in Tanks-Storage of ice cream and other milk products - in cold storage - Cleaning and Sanitation-Importance-Detergents-Properties-Cleaning procedures-Cleaning in place-Dairy effluent treatment and disposal.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Explain the technology of coagulated milk products and fermented milk
CO2: Summarize the manufacturing of frozen dairy products and dairy by-products
CO3: Select suitable thermal methods for extension of shelf life of milk
CO4: Outline the technology of fat-rich dairy products
CO5: Explain the production and examine the quality of different traditional dairy products
CO6: Understand the relevant regulations, standards and policies in Dairy industry

TEXT BOOKS:

1. Sukumar De, "Outlines of Dairy Technology", 1st Edition, Royal Oxford University Press, New Delhi, 2001
2. Warner, J.N., “Principles of Dairy Processing”, Wiley Eastern Pub. Co., New York, 1975
3 Walstra, P., “Diary Technology: Principles of Milk Properties and Processes”. Marcel Dekker, 1999

U23FTP71	DAIRY TECHNOLOGY LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To acquaint students with different sampling techniques applied to different milk
2. To learn and understand the principle, procedure and requirements for carrying out different tests of milk and milk products
3. To learn the methods of manufacture of different milk products.

LIST OF EXPERIMENTS

1. Experiment on titratable acidity, density and specific gravity of milk.
2. Platform tests (Acidity, COB, MBRT and Alcohol test).
3. Determination of fat and solids-not-fat contents of milk
4. Detection of adulterants in milk
5. Experiment on pasteurization and analysis of milk
6. Studies on standardization process of milk.
7. Development of flavored and fortified milk.
8. Development of paneer and channa
9. Determination of churning efficiency of butter churner.
10. Determination of efficiency of spray dryer
11. Preparation of Ice cream and low-fat frozen dessert.

TOTAL: 60 PERIODS

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl no	Name of the Equipment	Quantity
1.	Spray dryer	1
2.	Gerber centrifuge	1
3.	Butyrometer	4
4.	Lactometer	2
5.	Water bath	1
6.	Refractometer	2
7.	pH Meter	1
8.	Better Churner	1
9.	Homogenizer	1
10.	Refrigerator	1
11.	Pasteurizer	1
12.	Cream Separator	1

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Analyze physico-chemical properties of milk
CO2: Infer the technical aspects of raw milk processing
CO3: Appraise the factors affecting various dairy processes
CO4: Understand and adhere to Good Laboratory Practices (GLP)
CO5: Learn how to conduct sensory evaluation tests to assess the organoleptic properties
CO6: Learn how to perform quality control tests in Dairy products

U23FTP72	MINI-PROJECT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1 To develop their own innovative prototype of ideas.

2 To train the students in preparing mini project reports and examination.

The students in a group of 4 or 5 to do their works on a topic approved by the head of the department and prepares a comprehensive mini project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A mini project report is required at the end of the semester. The m project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Prepare their final year project work and find solution by formulating proper methodology.

CO2: Inculcate innovative thinking and thereby preparing students for main project.

CO3: Learn to make decisions on how to work independently to research and develop their project

CO4: Find new ideas on various Food processing methods

CO5: Involve in developing new food products, improving the safety and quality of existing products, or reducing food waste.

CO6: Able to communicate clearly and consicely the ideas and findings

U23FTP73	INDUSTRIAL TRAINING/INTERNSHIP - II	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. Get practical knowledge on production process in the industry and develop skills to solve related problems
2. Develop skills to carry out research in the research institutes/laboratories

The students individually undergo training in reputed firms/ research institutes / laboratories for the specified duration. After the completion of training, a detailed report should be submitted within tendays from the commencement of next semester. The students will be evaluated as per the Regulations.

No. of. days: 25 to 30

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Analysis of industrial / research problems and their solutions

CO2: To find solutions to the research problems

CO3: Documenting of material specifications

CO4: Documenting of machine and process parameters

CO5: Documenting of testing parameters and results

CO6: Preparing of Technical report and presentation

SEMESTER - VIII

		L	T	P	C
U23FTP81	**PROJECT WORK**	**0**	**0**	**10**	**10**

COURSE OBJECTIVES:

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.

To train the students in preparing project report and to face reviews and viva voice examination. The students in a group of 3 to 4 works on a topic approved by the head of the department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the head of the department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department

TOTAL: 300 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Take up any challenging practical problems and find solution by formulating proper methodology

CO2: Design and fabricate food processing equipments

CO3: Formulate and develop value added food products

CO4: Apply scientific research tools for design and optimization of food processing operations.

CO5: Work independently in different areas of food processing

CO6: To gain knowledge on different aspects related to food processing operations

ELECTIVE – MANAGEMENT COURSES

		L	T	P	C
U23GET71	**PRINCIPLES OF MANAGEMENT**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To sketch the Evolution of Management
2. To extract the functions and principles of management
3. To learn the application of the principles in an organization.
4. To study the various HR related activities.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS **9**

Definition of Management – Science or Art – Manager Vs Entrepreneur- types of managers-managerial roles and skills – Evolution of Management –Scientific, human relations, system and contingency approaches– Types of Business organization- Sole proprietorship, partnership, company-public and private sector enterprises- Organization culture and Environment – Currenttrends and issues in Management.

UNIT II PLANNING **9**

Nature and purpose of planning – Planning process – Types of planning – Objectives – Setting objectives – Policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and process.

UNIT III ORGANISING **9**

Nature and purpose – Formal and informal organization – Organization chart – Organization structure – Types – Line and staff authority – Departmentalization – delegation of authority – Centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management, Career planning and management

UNIT IV DIRECTING **9**

Foundations of individual and group behaviour– Motivation – Motivation theories – Motivational techniques – Job satisfaction – Job enrichment – Leadership – types and theories of leadership – Communication – Process of communication – Barrier in communication – Effective communication – Communication and IT

UNIT V CONTROLLING **9**

System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Productivity problems and management – Control and performance – Direct and preventive control – Reporting

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1:	Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.
CO2:	Have same basic knowledge on international aspect of management.
CO3:	Ability to understand management concept of directing.
CO4:	Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling.

CO5: Have same basic knowledge on international aspect of management.Ability to understand management concept of organizing.

CO6: Ability to understand management concept of organizing.

TEXT BOOKS:

1. Harold Koontz and Heinz Weihrich "Essentials of management" Tata McGraw Hill,1998.

2. Stephen P. Robbins and Mary Coulter, " Management", Prentice Hall (India)Pvt. Ltd., 10th Edition, 2009

REFERENCE BOOKS:

1. Robert Kreitner and MamataMohapatra, " Management", Biztantra, 2008.

2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, "Fundamentals of Management" Pearson Education, 7th Edition, 2011

U23GET72	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM.
2. Explain the TQM Principles for application.
3. Define the basics of Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA. Describe Taguchi's Quality Loss Function, Performance Measures and apply Techniques like QFD.
4. Teach the need for quality, its evolution, basic concepts, contribution of quality gurus, TQM framework, Barriers and Benefits of TQM. TPM, COQ and BPR.
5. Illustrate and apply QMS and EMS in any organization.

UNIT I INTRODUCTION **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of product and service quality –Definition of TQM-- Basic concepts of TQM - Gurus of TQM (Brief introduction) -- TQM Framework- Barriers to TQM –Benefits of TQM.

UNIT II TQM PRINCIPLES **9**

Leadership - Deming Philosophy, Quality Council, Quality statements and Strategic planning- Customer Satisfaction –Customer Perception of Quality, Feedback, Customer complaints, Service Quality, Kano Model and Customer retention — Employee involvement — Motivation, Empowerment, Team and Teamwork, Recognition & Reward and Performance Appraisal-- Continuous process improvement –Juran Trilogy, PDSA cycle, 5S and Kaizen - Supplierpartnership – Partnering, Supplier selection, Supplier Rating and Relationship development.

UNIT III TQM TOOLS & TECHNIQUES I **9**

The seven traditional tools of quality - New management tools - Six-sigma Process Capability- Bench marking - Reasons to benchmark, Benchmarking process, What to Bench Mark, Understanding Current Performance, Planning, Studying Others, Learning from the data, Using the findings, Pitfalls and Criticisms of Benchmarking - FMEA - Intent , Documentation, Stages: Design FMEA and Process FMEA.

UNIT IV TQM TOOLS & TECHNIQUES II **9**

Quality circles – Quality Function Deployment (QFD) - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures- Cost of Quality - BPR.

UNIT V QUALITY MANAGEMENT SYSTEM **9**

Introduction-Benefits of ISO Registration-ISO 9000 Series of Standards-Sector-Specific Standards -AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements-Implementation-Documentation-Internal Audits-Registration-ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001-Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1:	Ability to apply TQM concepts in a selected enterprise
CO2:	Ability to apply TQM principles in a selected enterprise.
CO3:	Ability to understand Six Sigma and apply Traditional tools, New tools, Benchmarking and FMEA.
CO4:	Ability to understand Taguchi's Quality Loss Function, Performance Measures and Apply QFD, TPM, COQ and BPR.
CO5:	Ability to apply QMS and EMS in any organization.
CO6:	Analyze and Evaluate Quality Management System

TEXT BOOKS:

1. Dale H. Besterfiled, Carol B. Michna, Glen H. Bester field, Mary B. Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, "Total Quality Management", Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression,2013.

REFERENCE BOOKS:

1. Joel.E. Ross, "Total Quality Management – Text and Cases",Routledge.,2017.
2. Kiran.D.R, "Total Quality Management: Key concepts and case studies, Butterworth –Heinemann Ltd, 2016.

U23GET73	ENGINEERING ECONOMICS AND FINANCIAL ACCOUNTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understanding the concept of Engineering Economics.
2. Implement various micro economics concept in real life.
3. Gaining knowledge in the field of macroeconomics to enable the students to have better Understanding of various components of macroeconomics.
4. Understanding the different procedures of pricing.

UNIT I DEMAND & SUPPLY ANALYSIS 9

Managerial Economics - Relationship with other disciplines - Firms: Types, objectives and goals - Managerial decisions - Decision analysis. Demand - Types of demand – Determinants of demand - Demand function — Demand elasticity - Demand forecasting - Supply – Determinants of supply - Supply function -Supply elasticity.

UNIT II PRODUCTION AND COST ANALYSIS 9

Production function - Returns to scale - Production optimization - Least cost input – Isoquants Managerial uses of production function. Cost Concepts - Cost function - Determinants of cost - short run and long run cost curves - Cost Output Decision - Estimation of Cost

UNIT III PRICING 9

Determinants of Price - Pricing under different objectives and different market structures -Price discrimination - Pricing methods in practice.

UNIT IV FINANCIAL ACCOUNTING (ELEMENTARY TREATMENT) 9

Balance sheet and related concepts - Profit & Loss Statement and related concepts - - Financial Ratio Analysis - Cash flow analysis - Funds flow analysis - Comparative financial statements - Analysis & Interpretation of financial statements.

UNIT V CAPITAL BUDGETING (ELEMENTARY TREATMENT) 9

Investments - Risks and return evaluation of investment decision - Average rate of return -Payback Period - Net Present Value - Internal rate of return.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions

CO2: Evaluate the economic theories, cost concepts and pricing policies

CO3: Understand the market structures and integration concepts

CO4: Understand the measures of national income, the functions of banks and concepts of globalization

CO5: Apply the concepts of financial management for project appraisal

CO6: Apply Engineering Economics principles to Financial Accounting Decisions

TEXT BOOKS:

1. Panneer Selvam, R, “Engineering Economics”, Prentice Hall of India Ltd, New Delhi,2001.

REFERENCE BOOKS:

1. Donald.G. Newman, Jerome. P. Lavelle, “Engineering Economics and analysis” Engg. Press, Texas, 2010
2. Degarmo, E.P., Sullivan, W.G and Canada, J.R, “Engineering Economy”, Macmillan, NewYork, 2011.

U23GET74	HUMAN RESOURCE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To provide knowledge about management issues related to staffing,
2. To provide knowledge about management issues related to training,
3. To provide knowledge about management issues related to performance
4. To provide knowledge about management issues related to compensation
5. To provide knowledge about management issues related to human factors consideration and compliance with human resource requirements

UNIT I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

The importance of human resources – Objective of Human Resource Management – Human resource policies - Role of human resource manager.

UNIT II HUMAN RESOURCE PLANNING 9

Importance of Human Resource Planning – Internal and External sources of Human Resources -Recruitment - Selection – Socialization.

UNIT III TRAINING AND EXECUTIVE DEVELOPMENT 9

Types of training and Executive development methods – purpose – benefits.

UNIT IV EMPLOYEE COMPENSATION 9

Compensation plan – Reward – Motivation – Career Development - Mentor – Protégé relationships

UNIT V PERFORMANCE EVALUATION AND CONTROL 9

Performance evaluation – Feedback - The control process – Importance – Methods – grievances – Causes – Redressal methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Students would have gained knowledge on the various aspects of HRM

CO2: Students will gain knowledge needed for success as a human resource professional.

CO3: Students will develop the skills needed for a successful HR manager.

CO4: Students would be prepared to implement the concepts learned in the workplace.

CO5: Students would be aware of the emerging concepts in the field of HRM

CO6: Analysis and Interpret Human Resource Data

TEXT BOOKS:

1. Decenzo and Robbins, "Human Resource Management", 8th Edition, Wiley, 2007.
2. Luis R,. Gomez-Mejia, DavidB. Balkin and Robert L. Cardy, “Managing Human Resources",7th Edition, PHI, 2012.
3. Dessler, "Human Resource Management", Pearson Education Limited, 2007.

U23GET75	KNOWLEDGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Learn the Evolution of Knowledge management.
2. Be familiar with tools.
3. Be exposed to Applications.
4. Gain knowledge on the concepts of some case studies.
5. Gain knowledge on management Applications.

UNIT I INTRODUCTION 9

Introduction: An Introduction to Knowledge Management -The foundations of knowledge management- including cultural issues- technology applications organizational concepts and processes- management aspects- and decision support systems. The Evolution of Knowledge management: From Information Management to Knowledge Management - Key Challenges Facing the Evolution of Knowledge Management - Ethics for Knowledge Management.

UNIT II CREATING THE CULTURE OF LEARNING AND KNOWLEDG SHARING 9

Organization and Knowledge Management - Building the Learning Organization. Knowledge Markets: Cooperation among Distributed Technical Specialists – Tacit Knowledge and Quality Assurance.

UNIT III KNOWLEDGE MANAGEMENT-THE TOOLS 9

Telecommunications and Networks in Knowledge Management - Internet Search Engines and Knowledge Management - Information Technology in Support of Knowledge Management - Knowledge Management and Vocabulary Control - Information Mapping in Information Retrieval - Information Coding in the Internet Environment - Repackaging Information.

UNIT IV KNOWLEDGE MANAGEMENT APPLICATION 9

Components of a Knowledge Strategy - Case Studies (From Library to Knowledge Center, Knowledge Management in the Health Sciences, Knowledge Management in Developing Countries).

UNIT V FUTURE TRENDS AND CASE STUDIES 9

Advanced topics and case studies in knowledge management - Development of a knowledge management map/plan that is integrated with an organization's strategic and business plan – A case study on Corporate Memories for supporting various aspects in the process life -cycles of an organization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the process of acquiry knowledge from experts.
CO2: Understand the learning organization.
CO3: Use the knowledge management tools.
CO4: Develop knowledge management Applications.
CO5: Design and develop enterprise applications.
CO6: Understand the Evolution of Knowledge management.

TEXT BOOKS:

1. Srikantaiah T. K., Koeing M., Knowledge Management for the information Professional, Information Today. Inc., 2000.

REFERENCE BOOKS:

1. 1. Nonaka, I., Takeuchi, H., "The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation", Oxford University Press, 1995.

U23GET76	INDUSTRIAL MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To study the basic concepts of management; approaches to management; contributors to management studies; various forms of business organization and trade unions function in professional organizations.
2. To study the planning; organizing and staffing functions of management in professional organization.
3. To study the leading; controlling and decision-making functions of management in professional organization.
4. To learn the organizational theory in professional organization.
5. To learn the principles of productivity and modern concepts in management in professional organization.

UNIT I INTRODUCTION TO MANAGEMENT 9

Management: Introduction; Definition and Functions – Approaches to the study of Management – Mintzberg's Ten Managerial Roles – Principles of Taylor; Fayol; Weber; Parker – Forms of Organization: Sole Proprietorship; Partnership; Company (Private and Public); Cooperative – Public Sector Vs Private Sector Organization – Business Environment: Economic; Social; Political; Legal – Trade Union: Definition; Functions; Merits & Demerits.

UNIT II FUNCTIONS OF MANAGEMENT - I 9

Planning: Characteristics; Nature; Importance; Steps; Limitation; Planning Premises; Strategic Planning; Vision & Mission statement in Planning– Organizing: Organizing Theory; Principles; Types; Departmentalization; Centralization and Decentralization; Authority & Responsibility – Staffing: Systems Approach; Recruiting and Selection Process; Human Resource Development (HRD) Concept and Design.

UNIT III FUNCTIONS OF MANAGEMENT - II 9

Directing (Leading): Leadership Traits; Style; Morale; Managerial Grids (Blake-Mounton, Reddin) – Communication: Purpose; Model; Barriers – Controlling: Process; Types; Levels; Guidelines; Audit (External, Internal, Merits); Preventive Control – Decision Making: Elements; Characteristics; Nature; Process; Classifications.

UNIT IV ORGANIZATION THEORY 9

Organizational Conflict: Positive Aspects; Individual; Role; Interpersonal; Intra Group; Inter Group; Conflict Management – Maslow's hierarchy of needs theory; Herzberg's motivationhygiene theory; McClelland's three needs motivation theory; Vroom's valence-expectancy theory – Change Management: Concept of Change; Lewin's Process of Change Model; Sources of Resistance; Overcoming Resistance; Guidelines to managing Conflict.

UNIT V PRODUCTIVITY AND MODERN TOPICS 9

Productivity: Concept; Measurements; Affecting Factors; Methods to Improve – Modern Topics (concept, feature/characteristics, procedure, merits and demerits): Business Process Reengineering (BPR); Benchmarking; SWOT/SWOC Analysis; Total Productive Maintenance; Enterprise Resource Planning (ERP); Management of Information Systems (MIS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO1:** Explain basic concepts of management; approaches to management; contributors to management studies;
- **CO2:** Discuss the planning; organizing and staffing functions of management in professional organization.
- **CO3:** Apply the leading; controlling and decision-making functions of management in professional organization.
- **CO4:** Discuss the organizational theory in professional organization.
- **CO5:** Apply principles of productivity and modern concepts in management in professional organization.
- **CO6:** Develop various forms of business organization and trade unions function in professional organizations.

TEXT BOOKS:

1. M. Govindarajan and S. Natarajan, "Principles of Management", Prentice Hall of India, New Delhi, 2009.
2. Koontz. H. and Weihrich. H., "Essentials of Management: An International Perspective", 8th Edition, Tata McGrawhill, New Delhi, 2010.

REFERENCE BOOKS:

1. Joseph J, Massie, "Essentials of Management", 4th Edition, Pearson Education, 1987.
2. Saxena, P. K., "Principles of Management: A Modern Approach", Global India Publications, 2009.
3. S.Chandran, "Organizational Behaviours", Vikas Publishing House Pvt. Ltd., 1994.
4. Richard L. Daft, "Organization Theory and Design", South Western College Publishing, 11th Edition, 2012.
5. S. TrevisCerto, "Modern Management Concepts and Skills", Pearson Education, 2018.

PROFESSIONAL ELECTIVE COURSES
VERTICAL I: FOOD PROCESSING TECHNOLOGY

		L	T	P	C
U23FTV11	**FRUITS AND VEGETABLES PROCESSING TECHNOLOGY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students :

1 Understand the status, challenges, and prospects of the global and Indian fruit and vegetable processing industry.
2 Learn post-harvest physiology and factors affecting deterioration.
3 Gain knowledge of pre-processing techniques like precooling, cleaning, and blanching.
4 Explore storage and preservation methods, including refrigeration, freezing, and irradiation.
5 Study advanced preservation techniques like hurdle technology, minimal processing, and edible coatings.

UNIT I PHYSIOLOGY AND PRE-PROCESSING OF FRUITS AND VEGETABLES **9**

Scope of Fruits and Vegetables Processing Industry in India and World-present status –constraints-prospects Classification of fruits and vegetables. Composition and nutrition aspects. Pre harvest and post-harvest changes. Concept of maturity indices-Factors leading to deterioration of fruits and vegetables. Methods to reduce post-harvest losses. Pre-processing of fruits and vegetables: Precooling, Cleaning, washing, sorting, grading peeling, blanching.

UNIT II POST-HARVEST STORAGE METHODS AND PRESERVATION TECHNIQUES **9**

Ambient conditions. Application of refrigeration concept in post-harvest storage, Freezing methods-Air Blast Freezer, Immersion Freezer, Cryogenic Freezer. Hypobaric Storage, CAS. Irradiation, Waxing. Trends in Packaging fresh produce-MAP, Inert and Vacuum Packaging. Concentration-freeze drying –osmotic dehydration, brining, syruping, canning.

UNIT III PROCESSING TECHNOLOGY OF FRUITS AND FRUIT BEVERAGES **9**

Unit operations involved in Juice preparation-equipments-screw type juice extractor, pulper, pressing, Rack and cloth press, Hydraulic Press, Filters, clarification and concentration by membranes.Classification of fruit juices- Squash, cordial, nectar, RTS. IMF products -Jam, Jelly, marmalade, candied preserves.

UNIT IV PROCESSING TECHNOLOGY OF VEGETABLE PRODUCTS, PRODUCTION OF SPECIALITY PRODUCTS **9**

Preparation and processing parameters of vegetable wafers, soup powders, pulp, puree, pastes, sauces, ketchups, chutneys. Preparation of various types of pickles. Dehydrated vegetable and leafy products. Processing parameters of mushroom and baby corn. Crystallized fruit, glazed fruit, fruit toffee, fruit powders, fruit leather and tutti-frutti.

UNIT V HURDLE TECHNOLOGY, MINIMALLY PROCESSED FRUITS AND VEGETABLES, EDIBLE COATING **9**

Types of hurdle, aspects of hurdle technology, stress- effect on fresh produce, shelf stable products. Factors affecting the shelf life and the quality of the minimally processed fruits and vegetables, physiology and biochemistry of the fresh cut fruits and vegetables. Processing, quality parameters and biochemical changes in the final quality of the fresh produce.

TOTAL: 45 PERIODS

		L	T	P	C
U23FTV12	**BAKING AND CONFECTIONERY TECHNOLOGY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Understand the classification and functions of bakery ingredients.
2. Learn about bakery equipment and dough rheology.
3. Study bread and cake making processes and their chemistry.
4. Understand the biscuit and confectionery making process.
5. Learn the composition and manufacturing of confectionery products.

UNIT I INTRODUCTION TO BAKING AND BAKING INGREDIENTS **9**

Classification of bakery products. Bakery Ingredients - Testing of raw materials and functions - flour, yeast, sugar, fat, egg, water, salt, coloring agents, flavoring agents, milk, milk powder, emulsifiers, leaveners, antioxidants and improvers.

UNIT II EQUIPMENTS IN BAKERY INDUSTRY AND RHEOLOGY OF DOUGH **9**

Handling of ingredients - dough mixers, dividers, rounder, sheeter, laminating equipments, fermentation enclosures and brew equipment, ovens and slicers. Farinograph, Amylograph, Alveograph, and Extensograph.

UNIT III BREAD MAKING PROCESS AND CAKE MAKING **9**

Chemistry of Dough Development. Bread making methods - Straight dough/bulk fermentation, Sponge and dough, Activated dough development, Chorleywood bread process, No time process.

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Gain insight into the scope and challenges of the fruits and vegetables processing industry

CO2: Apply post-harvest concepts to reduce losses and maintain quality.

CO3: Implement various pre-processing and preservation techniques for fruits and vegetables.

CO4: Identify and operate processing equipment for juice extraction and preservation..

CO5: Develop specialty products like jams, sauces, pickles, and dehydrated vegetables.

CO6: Apply modern techniques like hurdle technology and minimal processing to extend the shelf life of fresh produce.

TEXT BOOKS:

1. Thompson A.K., "Fruit and Vegetables: Harvest, Handling and Storage", 2nd Edition, Blackwell Publishing Ltd., Oxford, UK, 2003.

Characteristics of good bread - Internal and external characters. Bread defects/faults and remedies. Spoilage of bread. Ingredients and their function. Methods for different types of cakes manufacture.

UNIT IV BISCUIT MAKING AND CONFECTIONERY **9**

Composition and manufacturing process - Sugar boiled products - Candy, lollipop, lozenges. Toffees, fudge, caramel, aerated confectionery. Bubble gums and chewing gums. Chocolate Processing – chocolate shells, candy bars. Fruit confections. Confectionery product quality parameters, faults and corrective measures. Spoilage of confectionery products.

UNIT V CONFECTIONERY PRODUCTS **9**

Composition and manufacturing process - Sugar boiled products - Candy, lollipop, lozenges. Toffees, fudge, caramel, aerated confectionery. Bubble gums and chewing gums. Chocolate Processing – chocolate shells, candy bars. Fruit confections. Confectionery product quality parameters, faults and corrective measures. Spoilage of confectionery products.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Identify and test bakery ingredients for quality.

CO2: Operate bakery equipment and understand dough properties

CO3: Master different bread and cake making methods.

CO4: Apply techniques for biscuit and confectionery production.

CO5: Ensure quality control in confectionery products and troubleshoot defects.

TEXT BOOKS:

1. Yogambal Ashokkumar, "Text book of Bakery and Confectionery", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2012.

REFERENCE BOOKS:

1. .Weibiao Zhou and Hui Y. H., "Bakery Products Science and Technology", 2nd Edition, Wiley Blackwell, US, 2014.
2. Ferenc A. Mohos, "Confectionery and Chocolate Engineering: Principles and Applications", 1st Edition, Wiley Blackwell, UK, 2010.
3. Samuel A. Matz, "Bakery Technology and Engineering", 3rd Edition, Springer, US, 2008.

		L	T	P	C
U23FTV13	**PLANTATION AND SPICES TECHNOLOGY**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the processing of plantation crops such as tea, coffee, cocoa, and tuber crops.
2. Learn about the types, composition, and health benefits of spices and condiments.
3. Study the processing methods for major spices and the importance of spice oils.
4. Explore the types, nutritive value, and processing of herbs and flavoring materials.
5. Understand natural flavoring materials, extraction methods, and the biosynthesis of flavors

UNIT I PLANTATION CROPS 9

Plantation Crops: Description of various types of Plantation crops. Processing of tea – Manufacturing of black tea, CTC tea Green tea, Oolong tea, flavoured tea. Grading of Tea. Coffee – Occurrence, Manufacturing of coffee powder, instant coffee. Cocoa Processing – Cocoa liquor, cocoa powder manufacturing. Coconut – Processing and by products. Cashew nut and Oil palm Processing. Processing of tuber crops – tapioca. Processing of potatoes- processed potato products.

UNIT II SPICES AND CONDIMENTS 9

Spices and Condiments: Description of various types of spices and condiments, their composition, functional properties, flavouring agents. Nutritive value of spices and their health benefits. Importance in culinary preparations.

UNIT III PROCESSING OF SPICES 9

Processing of spices: Processing of spices – Pepper, Chilli, Turmeric, Cardamom, Cinnamon, Clove, Vanilla and Ginger. Spices Products – Liquid products and Solid Products. Importance of Cryogenic grinding of spices. Spice Oils – Concept and importance. Extraction methods - Solvent extraction, Steam distillation.

UNIT IV HERBS AND FLAVOURING MATERIALS 9

Herbs & Flavouring materials: Description of various types of herbs. Basil, Cilantro, Dill, Coriander, Mint, Oregano, Borage, Thyme, bilva leaves, Safflower. Nutritive value and health benefits. Processing and post - harvest handling.

UNIT V FLAVOURING MATERIALS OF NATURAL ORIGIN 9

Flavouring materials of natural origin: Natural flavours, sources of natural flavouring materials – Herbs and spices. Microbiology of spices, gas sterilization of spices, gamma irradiation, Heat treatment, Distillation, Extraction. Distillation of volatile oils, Application of spice essential oils. Oleoresins - Extraction, Quality and Application of oleoresins. Biosynthesis of flavours – Microorganisms, Enzymes, Plant suspension cultures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Gain knowledge of processing methods for plantation crops

CO2: Identify the functional properties and health benefits of spices and condiments.

CO3: Apply techniques for processing spices and extracting spice oils.

CO4: Understand the processing and benefits of various herbs and flavoring materials.

CO5: Master natural flavor extraction methods and biosynthesis techniques

TEXT BOOKS:

1. Kumar N., "Introduction to spices, plantation crops, medicinal and aromatic plants", 2nd Edition, Oxford and IBH Publishing, New Delhi, 2006..

REFERENCE BOOKS:

1. Panda H., "Handbook on Spices and Condiments (Cultivation, Processing and Extraction)", 2nd Edition, National Institute of Industrial Research, New Delhi, 2010
2. Peter K.V., "Handbook of Herbs and Spices", 2nd Edition, Wood head Publishing, USA, 2012.
3. Minifie Bernard W., "Chocolate, Cocoa and Confectionery Technology", 3rd Edition, Aspen publication, USA, 1999.

		L	T	P	C
U23FTV14	**TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the properties, composition, and storage systems of grains.
2. Learn about the rice milling process, including parboiling, husking, and whitening
3. Study wheat milling techniques and quality control measures.
4. Explore the processing methods for corn, millet, and sorghum
5. Learn the milling processes for pulses and oilseeds, including extraction and refining.

UNIT I GRAIN PROPERTIES 9

Grain Properties: Grains - Definition. Importance. Physical properties of grains. Structure, Composition and Nutritional value – paddy, wheat, maize, millet, oat, sorghum. Anti-nutritional factors and its methods of reduction. Grain storage systems - farm level storage, bagged storage, bulk storage, hermetic storage, outdoor storage. Losses during storage, Grain protection methods – physical and chemical methods. Integrated stored grain pest management.

UNIT II MILLING OF PADDY 9

Milling of Paddy: Rice milling flow sheet. Cleaning. Parboiling- traditional and improved methods, Physio–chemical changes during parboiling, Effect of parboiling on rice quality. Husking- Methods of husking, Huskers/Shellers – impact type, centrifugal dehusker, under runner disc huller, rubber rolls Sheller. Separation – indented tray and compartment type separator. Whitening – friction type and abrasive type whiteners. Color sorter. New quality control instruments. Byproducts from rice milling

UNIT III MILLING OF WHEAT 9

Milling of Wheat: Types of wheat. Wheat milling – Simple and detailed flow sheet. Cleaning, Entoleter. Preparation of Wheat for Milling – wheat blending, tempering or conditioning, Chakki milling, Roller milling – break rolls and reduction rolls, operation and corrugation specification, Sifting – Plan sifters, Purifying - purifier. Milling performance evaluation. Functional properties of flour. Flour treatment – Enrichment, Enhancement of flour appearance, Improvement of functional properties. By products from wheat milling.

UNIT IV PROCESSING OF CORN, MILLER AND SORGHUM 9

Processing of Corn: Types of corn. Dry milling – Tempering, dehulling, degermination and milling. Wet milling – Steeping, Germ, fiber, starch and gluten separation, starch refinement. By products from corn milling. Millet and Sorghum Processing: Types of millets. Sorghum and millet processing - cleaning, decortication, milling and classification, dry milled fractions. Food and Feed uses

UNIT V MILLING OF PULSES AND OIL SEEDS 9

Milling of Pulses: Legumes – Structure, Types, Nutritional and Anti-nutritional factors. Pulse Milling – Conditioning, Pitting, Oil/water treatment, drying, dehusking – TADD, CIAE design, Schule design, CFTRI design, Husk separation and grading, Splitting – Equipments. Milling - Dry and wet milling, Modern milling. Dehulling efficiency. Milling of Oil Seeds: Types of Oil seeds. Oil seed processing - Mechanical extraction – Hydraulic press, Screw press, Filter press. Mechanical extraction of coconut oil and palm oil. Cold pressing and Hot Pressing. Solvent extraction, Factors influencing extraction. Refining of oil. Hydrogenation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Identify grain properties, storage methods, and pest management techniques.

CO2: Understand the rice milling process and utilize byproducts

CO3: Master wheat milling techniques and flour treatment methods.

CO4: Apply processing techniques for corn, millet, and sorghum for food and feed use

CO5: Process pulses and oilseeds using modern extraction and refining techniques

TEXT BOOKS:

1. Chakraverty A., "Post-Harvest Technology of Cereals, Pulses and Oil Seeds", 3rd Edition, Oxford IBH Publishing Co. Pvt. Ltd, New Delhi, 2017..

REFERENCE BOOKS:

1. Kulp K. & Pont J.G., "Handbook of Cereal Science and Technology", 2nd Edition, Marcel Dekker Inc, New York, 2000.
2. Sahay K.M. & Singh K. K., "Unit Operations of Agricultural Processing", 2nd Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.

U23FTV15 MEAT, FISH AND POULTRY PROCESSING

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Understand meat types, processing, and preservation methods
2. Learn about fish composition, spoilage, and preservation techniques
3. Study poultry processing, quality factors, and preservation
4. Explore egg composition, processing methods, and quality control
5. Understand hygiene, sanitation, and safety practices in meat processing facilities

UNIT I MEAT PROCESSING 9

Types of meat and its sources, composition, structure of meat. Ante mortem handling, types of stunning, slaughtering of animals, inspection and grading of meat. Post-mortem changes of meat. Meat - tenderization, aging. Meat quality evaluation. Preservation of meat- curing, drying. Processed meat products - hamburgers, sausages and meat balls.

UNIT II FISH PROCESSING 9

Types of fish, composition and nutritive value of fish. Harvesting of fish. Spoilage factors of fish. Post-mortem changes in fish. Preservation - freezing and individual quick freezing. Canning and smoking operations. Salting, drying of fish and pickling.

UNIT III POULTRY PROCESSING 9

Types and characteristics of poultry products. Unit operation in poultry processing. Pre-slaughter factors affecting poultry meat quality. Factors affecting the shelf-life of poultry meat. Sensory quality of poultry meat- colour, texture and flavour. Preservation techniques: chemical treatments, heating-microwave & IR, freeze drying and irradiation.

UNIT IV EGG PROCESSING 9

Structure, composition, nutritive value of egg. Functional properties of eggs, Factors affecting egg quality and measures of egg quality. Preservation of egg by different methods. Egg powder processing-spray drying, foam mat drying..

UNIT V HYGIENE AND SANITATION 9

Modern abbatoirs, slaughterhouse and its features. Handling and maintenance of tools and core equipment. Cleaning and sanitation in meat plants. Food safety measures – GMP and GHP

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Identify meat types, process and preserve them effectively
CO2: Understand fish processing methods and spoilage control
CO3: Apply poultry processing and preservation techniques.
CO4: Process eggs and ensure their quality using preservation methods.
CO5: Implement sanitation and safety measures in meat plants

TEXT BOOKS:

1. 1.Warriss P.D., "Meat Science: An Introductory Text", 2nd Edition, CABI Publications, UK, 2009.

REFERENCE BOOKS:

1. Hui Y. H., "Handbook of Meat and Meat Processing", 2nd Edition, CRC Press, USA, 2012.
2. George M. Hall, "Fish Processing: Sustainability and New Opportunities", 1st Edition, Wiley Blackwell Publications, USA, 2011.
3. Isabel Guerrero-Legarreta, "Handbook of Poultry Science and Technology: Secondary Processing", 1st Edition, John Wiley and Sons Publications, UK, 2010

U23FTV16	FOOD PACKAGING TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the basic functions, design, and development of food packaging
2. Learn about the physical and chemical processes affecting product quality and shelf life predictions
3. Explore various types of food packaging materials, including paper, plastic, metal, and glass, along with their manufacturing processes and properties.
4. Understand the regulatory standards, labeling, and barcoding requirements in food packaging
5. Understand the basic functions, design, and development of food packaging

UNIT I Basics of Food Packaging 9

Definitions and basic functions of a food package. Food package design and development. Physical and physico-chemical processes affecting product quality, migration from packaging to foods, predicting the shelf life of foods. Package standards and regulation. Labeling, bar coding

UNIT II Paper and Paperboard Packaging 9

Paper and paperboard- manufacture, properties analysis and packaging aspects. Package types – pouches, sacks, cartons, boxes, tubes, tubs, labels, sealing tapes, cap liners and diaphragm etc.

UNIT III Plastic Packaging 9

Types of plastics used in packaging – PE, PP, PET, PVC, EVOH, PVA. Secondary conversion techniques – film, extrusion and thermal lamination. Printing of plastic films and rigid plastic containers. Natural extracts in plastic food packaging. Food contact and barrier properties. Sealability and closure.

UNIT IV Metal Cans 9

Raw materials for can making –steel, aluminum. Can making processes - three piece welded cans, DWI, DRD cans – end making processes, coating, film laminates and inks, corrosion and sulphur staining. Flash 18 process, retorting equipment. Definition and composition. Glass container manufacture – melting, forming, surface treatments. Closure selection. Glass bottle design and specification.

UNIT V Trends in Food Packaging 9

Active and intelligent packaging, modified atmosphere packaging - vacuum and inert gas packaging, biodegradable and edible packaging, aseptic packaging, self-heating and cooling cans. Recycling of non-biodegradable packaging materials

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the basic functions and design of food packaging

CO2: Know properties and uses of packaging materials like paper, plastic, metal, and glass..

CO3: Learn key packaging technologies and processes

CO4: Understand packaging regulations, labeling, and barcoding.

CO5: Gain awareness of modern trends like sustainable and intelligent packaging

TEXT BOOKS:

1. Richard Coles and Mark J. Kirwan, "Food and Beverage Packaging Technology", 2nd Edition, Blackwell Publishing Asia Pty Ltd, CRC Press, USA, 2011.

REFERENCE BOOKS:

1. Han Jung H., "Innovations in Food Packaging", 2nd Edition, Academic Press, USA, 2013

ELECTIVE II: FOOD ANALYSIS AND FOOD SAFETY

		L	T	P	C
U23FTV21	**INTRODUCTION TO FOOD ANALYSIS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the basic functions, design, and regulations of food packaging
2. Learn about paper and paperboard packaging materials and types
3. Study the properties and applications of plastic packaging
4. Explore metal and glass packaging processes and materials
5. Understand modern trends like active packaging, biodegradable materials, and recycling

UNIT I PRINCIPLES OF FOOD ANALYSIS 9

Nature and Concept of Food analysis, Basic instrumentation: Principle for pH meter, Dialysis, ultra filtration, Reverse osmosis. Centrifugation: Principle, Theory (RCF, Sedimentation coefficient) and types of Rotors, Ultracentrifugation, Calorimetry: Bomb calorimeter, Principle of Rheological Analysis- Rheological parameters, rheological methods, instruments and application, Texture profile analysis, Densimetry, Refractometry

UNIT II ANALYSIS OF CARBOHYDRATES AND PROTEINS 9

Carbohydrates: Definition, characteristics, properties, Sample preparation, Traditional methods: Physical methods of analysis, Chemical methods of analysis, Modern methods. Proteins: Introduction, Methods for measuring Protein Nitrogen: Kjeldahl method, Dumas method, Protein solubility, Methods of analysis of soluble protein: Biuret, Lowry, Bicinchocninic, ELISA methods.

UNIT III ANALYSIS OF LIPIDS, VITAMINS 9

Lipids: Introduction, Chemical Methods in Fatty acid analysis- Saponification value, Acid value, Iodine value, Polyunsaturated acids, Hydroxyl value, peroxide value, p-Anisidine value, Fatty acid analysis by Gas chromatography, HPLC, Qualitative analysis, quantitative analysis.Fat soluble Vitamins: Vitamin A,D,E,K , FSVs Analysis: Sample preparation, analytical methods. Water soluble vitamins, Methods of analysis of Vitamin C, Thiamin, Riboflavin, Niacin, Biotin, Folates.

UNIT IV ANALYSIS OF FIBERS AND OTHER COMPONENTS 9

Dietary Fiber: AOAC method 2011.25 for Total Soluble and Insoluble Dietary fiber, AOAC method 2009.01 for Total Soluble and Insoluble Dietary fiber, Alternative approaches to Dietary fiber analysis. Minerals : Determination of Ash, Dry ashing, Wet ashing, Microwave ashing, Determination of moisture, Sampling and Sampling preparation for moisture and Ash determination.

UNIT V Microbial analysis 9

Microorganisms in Food processing, Food safety problems and solutions, Principles of Food Microbiological analysis, Sampling and preparation of Microbiological analysis, Qualitative and quantitative analysis

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the basic functions, design, and regulations of food packaging

CO2: Learn about paper and paperboard packaging materials and types

CO3: Study the properties and applications of plastic packaging

CO4: Explore metal and glass packaging processes and materials

CO5: Understand modern trends like active packaging, biodegradable materials, and recycling

TEXT BOOKS:

1. Handbook of Food Analysis, Third Edition - Two Volume Set -- Leo M_L_ Nollet, Fidel Toldra -- 3rd ed, 2015 -- Crc Press
2. Food Analysis-Principles and Techniques (In 4 Volumes) -- Gruenwedel (Author) -- 1, 1984 Routledge

U23FTV22	INSTRUMENTAL TECHNIQUES AND METHODS FOR FOOD ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the principles and applications of instrumental methods like UV-Visible and IR spectroscopy
2. Learn X-ray, flame photometry, thermal methods, and morphology analysis
3. Study electrophoresis techniques and recent rapid detection technologies
4. Explore atomic absorption spectroscopy, NMR, and mass spectrometry.
5. Understand various chromatography and hyphenated techniques like GC-MS and LC-MS

UNIT I Introduction to Instrumental Methods and UV-Visible and IR Spectroscopy **9**

Classification of instrumental methods based on physical properties of molecules - The Electromagnetic spectrum - Interaction of photons with matter - Absorbance and transmittance - Beer and Lambert‟s laws. Deviation from Beer-Lambert‟s Law. Ultra violet and Visible spectrometry: Theory - Types of Transitions - Red and blue shifts - Instrumentation - Single beam and double beam spectrophotometers and applications. Fluorimetry: Theory - Factors affecting fluorescence - Instrumentation and applications. Infrared spectrometry: Requirements for IR absorption - Modes of vibrations - Instrumentation- Applications - Finger print region

UNIT II X-Ray and Flame Photometer and Thermal Methods and Morphology Analysis **9**

Absorption - Non-disperative Method - Diffraction - Rotating and powder crystal methods – Applications. Flame photometer, Polarimetry and Refractometry - Principle and instrumentation - Saccharimetry - Analysis of sugar. Thermogravimetry - Differential Thermal Analysis - Differential scanning calorimetry - Factors affecting the results - Instrumentation and applications. Morphology Analysis - Scanning Electron Microscopy - Transmission Electron Microscopy and Laser diffraction for particle analysis - Principle and Applications.

UNIT III Electrophoresis and Rapid Techniques **9**

Basic Principle of paper - Starch gel, agarose, PAGE, SDS-PAGE electrophoresis Immuno affinity techniques - Radio Assay Electrophoresis and applications. Isoelectric focusing, capillary electrophoresis- Microchip and 2D electrophoresis. Recent Development of Rapid Techniques - E sensors - e-nose, e-tongue instrumentation - Applications and working principles - Flow cytometry - Epifluorescence microscopy - Principle and Applications.

UNIT IV Atomic Absorption Spectrophotometer and NMR and Mass spectroscopy **9**

Principle, Advantages of ASS over FES - Instrumentation - Interference and applications. Nuclear Magnetic Resonance: Introduction to NMR - Energy levels of nucleus - Equivalent and non-equivalent protons - Chemical shift - Shielding - TMS - Factors affecting chemical shift - Splitting of signals and instrumentation (proton NMR) - Applications. Theory – components of mass spectrometer – Mass spectrum. Resolution of mass spectrometer. Types of ions produced –General rules for Interpretation of mass spectra -Fragmentation methods - Applications of mass spectra

UNIT V Chromatography Techniques and Hyphenated Techniques **9**

Introduction - Classification of chromatographic methods: Column chromatography, Thin Layer chromatography, Paper chromatography, Gas chromatography and High Performance Liquid Chromatography (HPLC) - Principle, important components and their functions mode of

separation, Instrumentation and applications. ICP-MS, HR-MS, HPTLC, GC-MS, LC-MS and GC- FTIR – Principle, Instrumentations and applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply UV-Visible and IR spectroscopy for molecular analysis..

CO2: Utilize X-ray and thermal methods for material characterization.

CO3: Apply electrophoresis and rapid techniques in analysis

CO4: Perform atomic absorption, NMR, and mass spectrometry for complex identification.

CO5: Use chromatographic and hyphenated techniques for separation and analysis

TEXT BOOKS:

1. Giles, “Design and Technology of Packaging Decoration for the Consumer Market”, Blackwell,2001.
2. Yam K. L., “The Wiley Encyclopedia of Packaging Technology”, Third Edition, Wiley, 2009
3. Klimchuk & Krasovec, “Packaging Design: Successful Product Branding from Concept to Shelf”.

U23FTV23	SENSORY ANALYSIS OF FOODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand sensory evaluation's role and perception in the food industry
2. Learn to plan sensory projects, including budgeting and experimental design
3. Master discriminative test methods for sensory analysis
4. Explore descriptive and affective tests for product assessment
5. Apply sensory evaluation in new product development and consumer research.

UNIT I INTRODUCTION **9**

Sensory evaluation – definition, Role of sensory evaluation in food industry, Sensory perception – vision, gustation, olfaction, touch, audition, multimodal perception. Factors affecting sensory measurements, Factors contributing to successful sensory evaluation. Requirements for sensory testing – Resources, Sample preparation and presentation, Assessors – screening and selection, training, motivation, advantages and disadvantages of internal and external panels

UNIT II SENSORY PROJECT PLANNING **9**

Product type, Budget, Timings, Selecting the test method, Setting action standards, Experimental design – treatment structure, design structure, Measurement scales, Sensory data analysis – types of data, distribution, data handling, choosing appropriate statistical test.

UNIT III DISCRIMINATIVE TEST METHODS **9**

Overall Difference tests - Triangle test, Duo-trio test, Difference from control test, Same and different test, „A" „not A" test. Attribute specific test - Paired comparison, Alternative forced choice, Ranking test. Similarity test - The power of the test, Proportion of true discriminators, Selecting the correct number of assessors.

UNIT IV DESCRIPTIVE TESTS AND AFFECTIVE TESTS **9**

Consensus profiling, Flavour Profiling, Texture Profiling, Quantitative Descriptive Analysis, Spectrum method, Free choice profiling, Flash profiling, Difference from control profiling, Temporal dominance of sensations. Questionnaire design, Qualitative methods - Focus groups, Preference tests, Acceptance tests, Attribute diagnostics. Linking consumer, sensory and product data. Advantages and disadvantages of test locations.

UNIT V SENSORY APPLICATIONS IN NEW PRODUCT DEVELOPMENT AND CONSUMER RESEARCH **9**

Adoption and use of Flash Profiling in standardizing new product development, Improving team tasting in the food industry, Alternative methods of sensory testing -working with chefs, culinary professionals and brew masters, Sensory testing with flavourists: challenges and solutions. Working with children, older people. Empathy and experiment – working with new population groups

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Conduct effective sensory evaluations based on perception factors

CO2: Plan and execute sensory projects with appropriate methodologies

CO3: Utilize discriminative tests to analyze differences in products

CO4: Implement descriptive tests and questionnaires for detailed sensory profiling

CO5: Apply sensory evaluation techniques to enhance new product development and understand consumer preferences

TEXT BOOKS:

1. Sarah Kemp, Tracey Hollowood, and Joanne Hor.t, "Sensory Evaluation: A Practical Handbook", 1st Edition, Wiley-Blackwell Publishers, UK, 2009.
2. Julien Delarue, J. Ben Lawlor and Michel Rogeaux., "Rapid Sensory Profiling Techniques and Related Methods", 1st Edition, Woodhead Publishing, UK, 2015.
3. Herbert Stone, Rebecca. N. Bleibaum and Hetaher A. Thomas., "Sensory Evaluation Practices",4th Edition, Academic Press,USA,2018.
4. **Sensory Applications in New Product Development an** Harry T. Lawless and ., "Sensory Evaluation of Food: Principle and Practices", 2nd Edition, Springer, UK, 2010.**d Consumer Research**

U23FTV24 **PRINCIPLES OF FOOD SAFETY**

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand the definition, principles, and importance of food safety
2. Identify and characterize food hazards, including physical, chemical, and biological
3. Learn about safety operations in food processing, including sanitation and GMP.
4. Explore the safety aspects of drinking water and its regulatory guidelines
5. Study food safety regulations, including the FSSAI framework and enforcement.

UNIT I Introduction **9**

Food safety- Definition; General principles of food safety. Need for 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 Physical and Chemical Food Hazard **9**

Metals, mineral (soil, engine oil, stones), plant (leaves, twigs, pods and skins), animal (hair, bone, excreta, blood, insects, larvae). Major pathways by which chemical residues and contaminants enter the food chain, Agrochemicals and veterinary drugs, packaging materials, process equipment and ingredient impurities. Food Adulterants, Food additives- permissible limits, concept of safe food.

UNIT III Safety Operations in Food Processing **9**

Plant Sanitation- Sanitizers, Cleaning chemistry CIP, Sanitation equipment. Personal hygiene, Good Manufacturing Practices: Prerequisites for Food Safety. HACCP-Concepts, implementation. Safety and Innovative Food Packaging. The Principles of Modern Food Hygiene.

UNIT IV Safety Aspects of Water **9**

Safety aspects of drinking water (microbiological and chemical) - the epidemiological triangle diseases caused by drinking of contaminated water, risks and advantages of chlorination of water, bottled water - origin of water- nutritional and physiological aspect – setting of guideline values (microbiological and chemical), Regulations for bottled water.

UNIT V Food Safety Regulations **9**

History of Food Safety Regulation. Food safety and Standards Act (FSSAI) – organizational chart – role of individual authority –principles to be followed - Enforcement of the act – Licensing and registration of food business – Food safety officer and their powers. Food safety Management Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Assess food safety hazards and sources of spoilage and contamination.

CO2: Identify physical and chemical hazards in the food chain and understand food safety measures.

CO3: Implement sanitation practices and HACCP in food processing environments

CO4: Evaluate the safety of drinking water and apply guidelines for water quality

CO5: Navigate food safety regulations and understand the role of food safety management systems.

TEXT BOOKS:

1. Schmidt R.H. and Rodrick G.E., ―Food Safety Handbook‖ 2nd Edition, John Wiley & Sons Inc, New Jersy, 2005.

REFERENCE BOOKS:

1. Kees A. van der Heijden, ―International Food Safety Handbook: Science, International Regulation, and Control‖, 1st Edition, CRC Press, 1999.

2. Rajesh Mehta and J. George, ―Food Safety Regulation Concerns and Trade - The Developing Country Perspective‖, 1st Edition, Macmillan India Ltd., New Delhi, 2005.

U23FTV25	FOOD SAFETY AND QUALITY CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Explore contemporary strategies for quality control and food safety.
2. Identify food hazards, contaminants, and their management
3. Understand microbial growth dynamics and predictive modeling
4. Learn about national and international food safety agencies and their roles
5. Implement and manage food quality management systems and standards.

UNIT I Contemporary Food Safety Strategies 9

Principles and need for quality control and safety, strategy and criteria for food safety. Consumer lifestyle and demand, issues in food safety, food traceability and recall, case against food biotechnology and irradiation. Case studies in food safety.

UNIT II Food Hazards and Contaminants 9

Characterization of food hazards, Food borne diseases and their control, food contaminants and their control. Naturally available toxins in foods, Cross contamination: toxicants resulting from food processing. Management of food allergens. Risk analysis of food hazards.

UNIT III Microbial Growth and Modelling 9

Inactivation of microbial growth - thermal and non-thermal methods, process dependent microbial modelling, integration of process and microbial growth modelling. Applications of predictive microbial modelling. Advanced methods for rapid detection of food spoilage.

UNIT IV Quality control and Food Safety Agencies, National and International Agencies 9

Quality control Importance, measures and procedures. BIS, AGMARK, FSSAI. Organizational structure and functions of United States Food and Drug Administration (USFDA), Global Food Safety Initiative (GFSI), International Consultative Group on Food Irradiation (ICGFI), European Food Safety Authority (EFSA), British Retail Consortium (BRC) global standards, Codex Alimentarius, Sanitary and Phyto-Sanitary measures (SPS), Plant Quarantine Act.

UNIT V Food Quality Management system 9

Duties and responsibilities of food safety regulators, food safety and standards for food products, implementation, validation, verification and improvement of food safety management systems. HACCP, Good Manufacturing Practices (GMP), Good Hygienic Practices (GHP), Good Laboratory Practices (GLP), ISO 22000, FSSC 22000, Food Safety Audit.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1:	Analyze consumer demands and issues related to food safety strategies
CO2:	Assess food hazards, control measures for foodborne diseases, and allergen management.
CO3:	Apply microbial growth models and rapid detection techniques in food safety
CO4:	Navigate the organizational structures of major food safety regulatory agencies.
CO5:	Develop and maintain effective food safety management systems, including HACCP and ISO standards

TEXT BOOKS:

1. F. A. Paine, The Packaging User's Handbook, Springer2.
2. Handbook of Paper and Paperboard Packaging Technology, Second Edition, by Mark J Kirwan

U23FTV26 FOOD LAWS- INDIAN AND INTERNATIONAL

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students:

1. Understand the framework and provisions of national and international food safety regulations.
2. Explore food regulatory affairs and the global food regulatory cycle
3. Learn about intellectual property rights (IPR) specific to the food industry and related documentation
4. Gain insights into the role and functions of the Food Safety and Standards Authority of India (FSSAI).
5. Familiarize with licensing, registration, and compliance systems in food safety.

UNIT I National and International Regulatory bodies 9

Food Safety and Standards Act of India, 2006: Provision, definitions and different sections of the Act and implementation, FSS Rules and Regulations, Overview of other relevant national bodies (e.g. APEDA, BIS, EIC, MPEDA, Spice Board etc.), International Food Control Systems/Laws, Regulations and Standards/Guidelines with regard to Food Safety – (i) Overview of CODEX Alimentarius Commission (History, Members, Standard setting and Advisory mechanisms: JECFA, JEMRA JMPR): WTO agreements (SPS/TBT), Important national and international accreditation bodies.

UNIT II Food Regulatory Affairs 9

Introduction to global regulatory authorities for food Industry, Food GMP and its regulations, From Farm to Fork: Understanding the Food Regulatory Cycle [International perspective of USA, Europe, UK, Canada, GCC (UAE), South Africa, Australia & New Zealand], Food safety in the process chain.

UNIT III Food Industry IPR 9

Documentation for launch of a new food product and regulatory filing in US, Europe, UK, India, Canada and Japan, Food Industry IPR, Patents, Copyrights and Trademarks, Food Product Marketing, Import and Export regulations, Compliance guidelines, Govt. Audits (FSSAI, BIS, etc), Food Regulations & Guidelines in India, Food Licensing & Registration in India, Industry based case studies.

UNIT IV FSSAI 9

FSSAI – Role, Functions, Initiatives (A General Understanding) Genesis and Evolution of FSSAI, Structure and Functions of Food Authority, Overview of systems and processes in Standards, Enforcement, Laboratory ecosystem, Imports, Third Party Audit etc., Promoting safe and wholesome Food (Eat Right India, Food Fortification, sniff, Clean Street Food Hub, RUCO and various other social and behavioral change initiatives).

UNIT V Licensing and Registration 9

Training and capacity building, Role of State Food Authorities. Food Safety Compliance System (FoSCoS), Food Safety Training and Certification (FoSTaC), Food Licensing and Registration System' or (FLRS), food business operators, Food Import Clearance System, Indian Food Laboratory Network, (INFoLNET) RUCO, Detect Adulteration with Rapid Test (DART) FSSAI e Books on Food Safety (pink, purple, Yellow, Orange etc.).

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TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Analyze the Food Safety and Standards Act, 2006, and its implementation in India

CO2: Evaluate the impact of global food regulations on the food industry and the "farm-to-fork" concept.

CO3: Navigate the documentation and regulatory filing processes for new food products in various countries.

CO4: Assess the initiatives and functions of FSSAI in promoting food safety and quality.

CO5: Implement food safety compliance systems and understand the licensing and registration processes for food businesses.

TEXT BOOKS:

1. Yam K. L., "The Wiley Encyclopedia of Packaging Technology", Third Edition, Wiley,2009

VERTICAL III: NEXT GENERATION TECHNOLOGIES IN FOOD INDUSTRIES

		L	T	P	C
U23FTV31	**HIGH PERFORMANCE COMPUTING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Facilitate students to understand parallel processing
2. Facilitate students to understand parallel programming models
3. Facilitate students to understand parallel programming languages
4. To understand about CUDA
5. To understand the concept of bioinformatics

UNIT I PARALLEL PROCESSING FUNDAMENTALS 9

Parallel Processing Concepts - Levels of parallelism - task, thread, memory, function; Models (SIMD, MIMD, Dataflow Models etc), Architectures- multi-core, multi-threaded

UNIT II PARALLEL PROGRAMMING MODELS 9

Parallel Programming and Multiprogramming, Programming Models in high performance computing architectures – Shared memory and Message passing paradigms - Fundamental Design Issues in Parallel Computing – Synchronization - Interconnect, Communication, Memory Organization Memory hierarchy and transaction specific memory design – Thread Organization.

UNIT III PARALLEL PROGRAMMING LANGUAGES 9

Parallel Programming Languages – Overview, OpenMP, History of GPUs leading to their use and design for HPC, Introduction to the GPU programming model and CUDA, host and device memories, Basic CUDA program structure, kernel calls, threads, blocks, grid, thread addressing, predefined variables

UNIT IV CUDA 9

CUDA - example code: vector and matrix addition, matrix multiplication, Using Windows and Linux environments to compile and execute simple CUDA programs, Linux make files, Timing execution time, CUDA events, Host synchronization

UNIT V BIOINFORMATICS AND PARALLEL COMPUTING 9

Bioinformatics and Parallel Computing- Bioinformatics Applications, Recent developments in Computational Biology and Nanotechnology and its impact on HPC

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: learn parallel computing
CO2: Learn parallel programming languages
CO3: Learn the concepts of parallel processing
CO4: Gain knowledge on CUDA
CO5: Gain knowledge on bioinformatics
CO6: Aware of recent techniques in nanotechnology

TEXT BOOKS:

1. Highly Parallel Computing", by George S. Almasi and Alan Gottlieb
2. Advanced Computer Architecture: Parallelism, Scalability, Programmability, by Kai Hwang, McGraw Hill 1993
3. CUDA by Example- An Introduction to General-Purpose GPU Programming by Jason Sanders and Edwards Kandrot Addison-Wesley, 2011.
4. "Parallel Computer Architecture: A hardware/Software Approach", by David Culler Jaswinder PalSingh, Morgan Kaufmann, 1999

REFERENCE BOOKS:

1. Jeffrey S. Vetter (Editor), Contemporary High Performance Computing: From Petascale toward Exascale (Chapman & Hall/CRC Computational Science) CRC Press, 2013
2. Georg Hager, Gerhard Wellein, Introduction to High Performance Computing, CRC Press, 2011
3. Wagner, S., Steinmetz, M., Bode, A., Müller, M.M. (Eds.), High Performance Computing In Science and Engineering, Garching / Munich, Springer Verlog, 2010.

U23FTV32	FOOD MATERIALS SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Impart an understanding on the microstructural and molecular basis of food materials.
2. Emphasize the formation and structure of food biopolymers.
3. Deliver the technologies for characterization of engineered/ structured food materials

UNIT I INTRODUCTION 9

Fundamentals of food materials, Molecular basis of food materials, Observation of materials at various size ranges and size-property relationship, The Composite Structure of Biological Tissue, Amorphous and crystalline structures of materials, Gel structures of food materials, Interfacial properties of the food materials.

UNIT II MICRO TO MACRO LEVEL STRUCTURES OF FOOD MATERIALS 9

Microstructure definitions**,** Measurement of microstructures/nanostructures**,** The relationship between structure and quality**,** Microstructure and emulsions, Fibrous Composites, Visualisation of surface structures, Interfacial assembly of food materials, The dynamic interface, Phase and state transition

UNIT III FOOD GELS 9

Introduction to food biopolymers, Rheology of food gels: yielding and gelling soft matter, Formation and structure of biopolymer network gels, Formation and structure of micro- and nano-gel particles, Structure–rheology relationships of food gels and food gel structures.

UNIT IV FOOD MATERIAL CHARACTERIZATION 9

Introduction**,** Material Characterization Techniques; Nuclear Magnetic Resonance (NMR)**,** Fourier Transform Infra-Red (FT-IR)**,** X-ray powder diffraction**,** Small angle neutron & X-ray scattering (SANS and SAXS)**,** Confocal microscopy**,** Scanning electron microscopy**,** Atomic Force Microscopy (AFM).

UNIT V FOOD MATERIAL ENGINEERING 9

Food structure and bio-accessibility of nutrients, Effects of Processing Technologies on Food Material, Properties, Technologies for protection and delivery of nutrients, State Diagrams of Food Materials, Probing food structure, Food design based on the supplemented diagram, Design of foods and encapsulation systems, Food Nanoparticles: Formation, Properties and Applications

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Explain the basic terms in food material engineering.
CO2: Understand the microstructural and molecular basis of food materials.
CO3: Acquire knowledge to the formation and structure of food biopolymers.
CO4: Interpret the technologies for characterization of engineered/ structured food materials
CO5: Understand the recent characterization techniques of food materials
CO6: Understand the engineering properties of food materials

TEXT BOOKS:

1. Bhesh Bhandari & Yrjö H. Roos. “Food Materials Science and Engineering” Wiley-Blackwell Publishing, 2012.
2. José Miguel Aguilera & Peter J. Lillford, “Food Materials Science - Principles and Practice”, Springer New York, 2008.
3. Alexandru Mihai Grumezescu & Alina Maria Holban, “Handbook of food bioengineering” Elsevier Science, 2018.
4. Charis Michel Galanakis, “Food Structure and Functionality” Elsevier Science,2020

U23FTV33	FOOD STRUCTURING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Introduce the techniques of developing structured food products.
2. Comprehend the structure development in various food matrices.
3. Evaluate the technical and functional performance of structured food materials
4. Evaluate the structure of foods containing polyphases
5. Analyse the different properties of foods

UNIT I INTRODUCTION 9

Nature of food structure, Food structure development, Role of hydrocolloids and proteins in food structure development, making of structured foods, Destruction, destabilization and deformation of food matrix, Application of materials science in food design and development of engineered food materials**,** the systematic approach to food engineering systems (SAFES), Complex Disperse System (CDS) formalism, Top-down and Bottom-up strategies of constructing food matrix. Modelling and Computer Simulation Approaches to Understand and Predict Food Structure Development.

UNIT II TECHNIQUES FOR FIBROUS STRUCTURE FORMATION 9

Cultured meat, Mycoprotein, Wet spinning, Electrospinning, Extrusion, Mixing of proteins and hydrocolloids, Freeze structuring, Shear cell technology.

Food Printing: 3D food printing; Approaches, Technologies in food printing, Printability of food components, Factors affecting the printability, 4D Printing; Concept and Functionality, smart food materials, shape memory effect in 4D food printing, Deformation and breakup, Coalescence and alignment, Applications of 3D and 4D food printing.

UNIT III FOOD STRUCTURE DEVELOPMENT IN EMULSION SYSTEMS 9

Emulsions: Principles and Preparation, Basic constituents of Food emulsion, Emulsion architecture, Microstructure design and performance. Food Structure Development in Oil and Fat Systems; nanoscale crystals and the structures of lipids and fat, fat crystal network. Role of bubbles in food structure development; Formation of foam/bubble microstructures, Rheological behaviour, Characteristics of bubble-containing structures.

UNIT IV STRUCTURING POLYPHASIC FOOD SYSTEMS 9

Structuring Dairy Products by means of Processing and Matrix Design, Processing of Food Powders, Structured Cereal Products, Structured Meat Products, Structured Chocolate Products, Edible Moisture Barriers for Food Product Stabilization. Encapsulation of food materials; Micro and nano encapsulation, selection of wall and core materials, structural characterization of encapsulates.

UNIT V PERFORMANCE OF STRUCTURED FOOD 9

Food Structure Development for Rheological/Tribological Performance; structure-property-oral process relationships. Developing Food Structure for Mechanical Performance; structure and bulk behavior of soft solid foods, particulate composites and gels, cellular solid foams, and short fiber-reinforced foods. Design Structures for Optimal Sensory Performance, Development of Food Structures for the Encapsulation and Delivery of Bioactive Compounds

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Aware techniques of developing structured food products.

CO2: Understand the concepts and principles of food structuring.

CO3: Assimilate the modern techniques of food structure development.

CO4: Evaluate the technical and functional performance of structured food materials

CO5: Evaluate the methods for determining the structure of foods containing polyphases

CO6: Understand the methods for analyzing the structure of foods

TEXT BOOKS:

1. Fotis Spyropoulos, Aris Lazidis & Ian Norton, “Handbook of Food Structure Development” Royal Society of Chemistry, 2020.
2. Bhesh Bhandari & Yrjö H. Roos. “Food Materials Science and Engineering” Wiley-Blackwell Publishing, 2012.
3. José Miguel Aguilera & Peter J. Lillford, “Food Materials Science - Principles and Practice”, Springer New York, 2008.
4. Alexandru Mihai Grumezescu & Alina Maria Holban, “Handbook of food bioengineering” Elsevier Science, 2018

U23FTV34	CONCEPTS ON EXPERIMENTAL DESIGN AND MODELLING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Introduce students to Experimental Design Fundamentals, Single Factor, Multifactor Experiments and Taguchi Methods.
2. Describe how to design experiments, carry them out, and analyze the data they yield.
3. Gain an understanding of how the analysis of experimental design data is carried out using the most common software packages
4. Gain knowledge on analysis and interpretation methods
5. Understand methods for experimental design

UNIT I INTRODUCTION TO EXPERIMENTAL DESIGN 9

Importance of experiments- experimental strategies, basic principles of design, terminology. Concepts of random variable, probability, density function cumulative distribution function. Sample and population. Measure of Central tendency- Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions- Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size, normal probability plot, linear regression model.

UNIT II DESIGN OF EXPERIMENTS -SINGLE AND MULTIFACTOR EXPERIMENTS 9

Types of Design of experiments- Completely randomized design, Randomized block design, Latin square design, Two and three factor full factorial experiments, 2K factorial Experiments, Confounding and blocking designs, Plackett- Burman design.

UNIT III SPECIAL EXPERIMENTAL DESIGNS 9

Fractional factorial design, Nested designs, Split plot design, Response Surface Methodology (RSM), Experiments with random factors, rules for expected mean squares, approximate F- tests.

UNIT IV ANALYSIS AND INTERPRETATION METHODS 9

Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments- one way ANOVA, two way ANOVA and multi way ANOVA, Pairwise comparison- Tukey's test and Fisher LSD test, Regression analysis, Statistical analysis, estimation of model parameters, model adequacy checking, Forming mathematical models from experimental data- First order, second order models

UNIT V DESIGN OF EXPERIMENTS 9

Design using Orthogonal Arrays, Data analysis, Robust design- control and noise factors, S/N ratios, parameter and tolerance design concepts, case studies

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the basic concepts related to experimental design
CO2: Understanding the different types of design and its relevance to real time experiments.
CO3: Gain knowledge in analyzing the design and developing appropriate models
CO4: Gain knowledge on special experimental designs
CO5: Understand the application of ANOVA in experimental design
CO6: Understand the methods for designing experiments

		L	T	P	C
U23FTV35	**STATISTICAL TOOL IN DATA ANALYSIS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Provide an insight into various statistical tools in data analysis.
2. Provide an insight into the real-life and varied application of the subject
3. Provide an insight into data management
4. Learn statistical data analysis
5. Understand the softwares and tools for data analysis

UNIT I INTRODUCTION TO SCIENCE OF STATISTICS 9

Fundamental Elements of Statistics, Qualitative and Quantitative Data Summaries, Statistical Inference, Stating Hypotheses, Test Statistics and p-Values, Evaluating Hypotheses, Equation of multiple linear regression, Interpretation of multiple linear regression, Cautions about Regression

UNIT II DATA MANAGEMENT AND ANALYSIS 9

Quantitative analysis, descriptive statistics, inferential statistics: Uses and limitations Summation sign and its properties, Proportions, percentages, ratios, Measures of central tendency-mean, median, mode arithmetic mean and its uses, mid – range, geometric mean, weighted mean, measures of dispersion /variability- range, variance, standard deviation, standard error, coefficient of variation, Kurtosis, Sleekness (practical aspects of grouped data- frequency distribution, histogram, frequency polygons, percentiles, Data Management and Analysis, Frequency distributions, Measures of central tendency, measures of dispersion, variability).

UNIT III STATISTICAL DATA ANALYSIS USING SPSS 9

Data handling: open SPSS data file – save – import from other data source – data entry – labelingfor dummy numbers - recode in to same variable – recode in to different variable – transpose of data – insert variables and cases – merge variables and cases. Testing of Hypothesis: Parametric– One sample – Two sample independent t – test – Paired t – test. Non – parametric: One sample KS test- Mann-Whitney U test – Wilcoxon Signed Rank test
- Kruskal Wallis test – Friedman test-Chi- square test.

UNIT IV DATA ANALYTICAL MODELS 9

Reducing Data Complexity (Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA)), Additional Linear Model Topics (Collinearity, Logistic, Hierarchical Linear Models (HLM)), Confirmatory Factor Analysis and Structural Equation Modeling (SEM).

UNIT V DATA ANALYTICS: SOFTWARES AND TOOLS 9

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO1:** Collect, store, process and analyze data according to high standards
- **CO2:** Conduct empirical research in food science and technology using modern analytic softwaretools
- **CO3:** Develop and apply new research methods
- **CO4:** Solve problems using best practices of data analysis using modern computational tools.
- **CO5:** Reduce data complexity using different analysis
- **CO6:** Learn softwares and tools for data analysis

TEXT BOOKS:

1. Gupta, S. (2001) “Research Methodology and Statistical Techniques”, Deep and Deep, New Delhi.
2. Heumann, C., Schomaker, S., Introduction to Statistics and Data Analysis: with Exercises, Solutions and Applications in R. Springer, 2016
3. Teetor, P. (2011). R cookbook: Proven recipes for data analysis, statistics, and graphics. O'Reilly Media, Inc.

U23FTV36	INTERNET OF THINGS IN FOOD AND AGRICULTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Understand IoT applications in smart agriculture and related technologies.
2. Explore RFID and big data in food industry management and blockchain applications.
3. Apply IoT for detecting food spoilage and enhancing food safety.
4. Learn about food traceability technologies for real-time monitoring.
5. Examine IoT solutions for food waste management.

UNIT I IoT IN AGRICULTURE 9

Smart agriculture, type of IoT sensors for agriculture – monitoring of climate conditions, Greenhouse automation, crop management, cattle monitoring and management, End-to-End farm management systems. Benefits and applications of smart farming, Issues and challenges in food and agriculture- efficient routing protocols and ambient energy harvesting for IoT

UNIT II IoT IN FOOD 9

RFID and sensor network integration in food industry-RFID in food production, food supply chain, retailing and sustainability. RFID in sensor network and food processing-Case studies-Big data analytics in food industries-Food supply chain visibility, Intelligent food supply chain. Block chain-Concepts-Potential Applications in Food Industry

UNIT III IoT IN FOOD SPOILAGE AND SAFETY 9

Importance of IoT concerning food quality, safety and security. Biosensors for detection of food borne pathogens – prevention & retardation of food spoilage. Microbial detection, GIS, Sensor Networks. Case study on ensuring safety by enhanced IoT. IoT linked wearable devices for managing food safety in the healthcare sector.

UNIT IV IoT IN FOOD TRACEABILITY 9

Food Traceability: Need of new technologies in food traceability systems. Architecture of traceability system- ICT & Electronic Product Code (EPC) enabled systems. Real time tracking and remote monitoring – Wireless sensing technologies, remote communications and Intelligent traceability.

UNIT V IoT IN FOOD WASTE MANAGEMENT 9

Food Waste Management: Scope and significance of IoT in food waste management. Smart Garbage System (SGS)- components, design, architecture of SGS, implementation and efficiency, real-time application in food waste minimization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1:	Apply the concept of IoT for management of agriculture
CO2:	Apply the concept of IoT for management of food and supply chain
CO3:	Make use of appropriate IoT concepts for rapid detection of food spoilage
CO4:	Utilize IoT methods to solve food traceability
CO5:	Utilize IoT methods to solve food waste management problems

TEXT BOOKS:

1. Qusay F. Hassan, Attaur Rehman Khan, Sajjad A. Madani., “Internet of Things Challenges, Advances and Applications”, 1st Edition, CRC Press, Taylor and Francis Group, 2017
2. Selwyn Piramuthu, Weibiao Zhou., “RFID and Sensor Network Automation in the Food Industry: Ensuring Quality and Safety through Supply Chain Visibility”, 1stEdition, John Wiley & Sons, UK, 2016.
3. Montserrat Espiñeira, Francisco J. Santaclara., “Advances in Food Traceability Techniques and Technologies - Improving Quality Throughout the Food Chain”, 1stEdition, Wood head Publishing, 2016.

VERTICAL IV: FOOD BIOTECHNOLOGY

U23FTV41	INTRODUCTION TO FOOD BIOTECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Acquaint with the fundamentals of biotechnology in relation to raw materials for food processing.
2. Enable the students to learn about food fermentations, waste utilization and use better genetic resources in food industry

UNIT I FOOD BIOTECHNOLOGY 9

Fermentative production of enzymes used in food industry; solid state fermentation; recovery of enzymes from natural sources; cheese making and whey processing, impact of enzyme technology (bioethanol, protein hydrolysates, bioactive peptides); enzymatic processing of fruit juices. Role of enzymes in baking, meat and meat processing; comparative methods of toxicity test in (novel) foods; biosensors; enzymatic approach to tailor made fats; catabolic processes and oxygen-dependent reactions in food; use of lipases and reactions in organic solvents and two Phases

UNIT II OVERVIEW OF GENETICS 9

Chemical structure of nucleic acids, proteins; introduction to Genetics, DNA replication,transcription and translation; cell division, cell cycle, mitosis, meiosis; introduction to human genetics; Mendelian genetics; single cell disorders; complex traits; mutation, types of mutations DNA repair mechanism; modifying enzymes; mutation and polymorphism and their detection;family based and case control study designs; pedigree analysis; linkage analysis and association studies

UNIT III GENETIC ENGINEERING 9

Overview of recombinant DNA technology and its applications. Characteristics and importance: Cloning vector and expression vector, Transformation, Transfection and Transduction – Principle and differences. Plasmid vector: Cloning site, Selection, Screening, PCR, RT-PCR, electrophoresis, electro blotting and capillary blotting, applications to produce genetically modified foods

UNIT IV CELL CULTURE TECHNOLOGY 9

Introduction to plant and animal tissue cultures and cell cultures in general. Cell culture lab design and equipment, Media and reagents. Animal, mammalian, and other cell lines for in-vitro testing of drugs, toxicity of environmental pollutants, production of vaccines and therapeutic proteins & production of stem cells. Principles of cryobiology and molecular diagnostics, Technological aspects for commercial utilization of cell cultures: Reactor studies, scale up and biosafety.

UNIT V TRANSGENIC TECHNOLOGY & APPLICATIONS IN FOODS 9

DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid. Genetically engineered proteins Bovine Somatotropin in Milk; Genetically engineered bacteria Chymosin Lite beer; Tryptophan; Transgenic plants CalgeneFlavrSavrTM tomato, Monsanto Round-Up TM Ready, Ciba Geigy Basta TM resistant crops; Edible vaccines Cholera vaccine in potatoes; Transgenic Fish Atlantic salmon

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Apply the principles of biotechnology in Food processing industries to improve the quality offoods

CO2: Execute the production of commercially important metabolites

CO3: Apply the principle of downstream processing and explain various stages involved in downstream processing

CO4: Evaluate the diagnostic techniques for food borne pathogens and toxins

CO5: Assess the safety aspects and social issues related to applications and implications of genetically modified foods

CO6: Assess the implications of genetically modified foods

TEXT BOOKS:

1. B.D. Singh. "Biotechnology - Expanding Horizons", Kalyani Publishers, 2014.
2. Meenakshi Paul. "Biotechnology and Food Processing Mechanics", Gene-Tec Books, 2007.
3. James D. Watson. "Molecular Biology of the Gene", 7th Edition. Benjamin Cummings, 2013.
4. Oliver Brandenberg, Zephaniah Dhlamini, Alessandra Sensi, Kakoli Ghosh and Andrea.
5. Sonnino. "Introduction to Molecular Biology and Genetic Engineering". FAO, 2011.
6. S.B. Primrose and R.M. Twyman. "Principles of Gene Manipulation and Genomics", 7 thEdition.
   Blackwell Publishing, 2006.
7. Ashok Agarwal and Pradeep Parihar. "Industrial Microbiology Fundamentals and Applications" Agrobios, 2005

REFERENCE BOOKS:

1. Bains W. "Biotechnology from A to Z", Oxford Univ. Press., 2004, 3rd Edition
2. Joshi VK & Pandey A. "Biotechnology Food Fermentation"., Vols. I, 2nd Edition. Education Publ.1999.
3. Knorr D. "Food Biotechnology"., Marcel Dekker., 1985.
4. Lee BH. "Fundamentals of Food Biotechnology"., VCH., 1996.
5. Perlman D. "Annual Reports of Fermentation Processes"., 1979.

U23FTV42	ENZYMES IN FOOD AND FEED INDUSTRY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To highlight the action and mechanism of microbial enzymes and fermentative production ofenzymes followed by isolation and purification
2. To analyze the role of specific enzymes in the processing of dairy, bakery, brewery, fruitand vegetable products, plantation crops.
3. To analyze the role of specific enzymes in starch industry, confectionary, protein hydrolysis, extraction of oil.
4. To analyze the role of specific enzymes in processing of meat, seafood and poultry products, waste management, animal feed industry.
5. To analyze the role of specific enzymes as biosensors, additives, in packaging, and describe the concept of recombinant enzymes and safety of enzymes

UNIT I INTRODUCTION TO ENZYMES 9

Classification of enzymes. Mechanisms of enzyme action; concept of active site and energetics ofenzyme substrate complex formation. Kinetics of single substrate reactions; estimation of Michaelis – Menten parameters, multisubstrate reactions- mechanisms and kinetics; turnover number; types of inhibition & models –substrate, product

UNIT II ENZYMES IN FOOD INDUSTRY 9

Introduction to enzymes used in Food industry, Objectives of using enzymes in food processing and in food product development, Merits and demerits of using enzymes, Sources of enzymes, Microbial enzymes and their advantages/ disadvantages, Commercially important enzymes used in Food industry and their mode of action, Overview of applications of enzymes in the Food industry, Newer enzymes and their actual and potential applications, Fermentative production of enzymes used in food industry by SSF or SmF, Recovery and purification of enzymes.

UNIT III ENZYME APPLICATIONS IN FOODS 9

Use of enzymes in: Dairy, Bakery, Brewery, Fruit and Vegetable Processing, Plantation Products, Starch industry and confectionery, Protein hydrolysis for protein hydrolysate and bioactive peptides, Oilseeds processing, formation of TAGs, extraction of fish oil, meat, seafood (surimi product), poultry, eggs, treatment of wastes from food industry, flavor biotransformations

UNIT IV APPLICATIONS OF ENZYMES IN FEED INDUSTRY 9

The benefits of supplementation of exogenous enzymes to feed. Use of enzymes in poultry and animal feed.

UNIT V ADVANCES IN UTILIZATION OF ENZYMES 9

Enzymes in biosensors, Enzymes as additives e.g. antioxidant or antimicrobial, Novel food applications of enzymes, Enzymes in active packaging and in edible coatings and films, safety of enzymes used in foods, food grade enzymes, Immobilization of enzymes for food applications, Recombinant enzymes from GMO.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Highlight the action and mechanism of microbial enzymes and fermentative production ofenzymes followed by isolation and purification.

CO2: Analyze the role of specific enzymes in the processing of dairy, bakery, brewery, fruit andvegetable products, plantation crops.

CO3: Analyze the role of specific enzymes in starch industry, confectionary, protein

hydrolysis,extraction of oil.

CO4: Analyze the role of specific enzymes in processing of meat, seafood and poultry products,waste management, animal feed industry.

CO5: Analyze the role of specific enzymes as biosensors, additives, in packaging,

CO6: Describe the concept of recombinant enzymes and safety of enzymes.

TEXT BOOKS:

1. Robert Rastall., (2007), Novel Enzyme Technology for Food applications, 1st ed, CRC Press,U.S.
2. Marwaha, (2002). Food Processing: Biotechnological Applications, Asiatic Publishers, NewDelhi

REFERENCE BOOKS:

1. Mohammed Kuddus (2018) Enzymes in Food Technology- Improvements and Innovations, Springer Singapore
2. Robert J. Whitehurst, Maarten Van Oort (2009) Enzymes in Food Technology, second edition, Blackwell Publishing.

U23FTV43	FOOD FERMENTATION TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students to:

1. Impart knowledge and skills related to process technologies in fermented food products
2. Learn about the different equipment used for the production of various fermented food products

UNIT I HISTORICAL PERSPECTIVE OF FOOD FERMENTATION 9

History of food fermentations; types of fermented foods and substrates/raw materials used, traditional fermented foods, biotransformation of raw materials

UNIT II FERMENTING ORGANISMS AND THEIR ROLE 9

Principles of food and industrial fermentations; microorganisms of importance in food fermentations, Biochemistry of fermentations/fermentation pathways. Lactic Acid Bacteria and starter cultures (Taxonomy, ecology, physiology, genetics and biotechnology, phage control) Brewers and Bakers yeasts, Yeast starter culture maintenance, Moulds used in food fermentations; Genetic manipulation of fermenting microbes, Strain specific traits

UNIT III TECHNOLOGY OF FERMENTED FOODS 9

Dairy fermentations - Yeast fermentations - Wine and beer fermentations, bread making, Mould fermentations – soy based fermented foods – miso, tempeh, soy sauces Manufacture of cheese,yoghurt, wine, beer, bread, soy sauce; processes and equipment used for manufacture; bottling / packaging, aging, storage and shelf life of fermented foods; Prevention of spoilage of fermentations.

UNIT IV PRODUCTS OF MIXED FERMENTATIONS 9

Meats, sausages, fish sauces, sauerkraut, idli, Manufacture of different types of sausages, fish sauces, sauerkraut, idli batter- processes and equipment used for manufacture; packaging, aging, storage and shelf life of the products; Prevention of spoilage of fermentations

UNIT V OTHER PRODUCTS FROM FERMENTATION 9

Fermentation production of flavor components, acids, alcohol, enzymes, pigments/colours.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understanding concepts, principles and procedures involved in the area of fermented food production.

CO2: Familiarizing with different fermenter types and their design criteria

CO3: Understand the technology involved in the fermented foods

CO4: Understand the methods for the production of fermented foods

CO5: Know more about the organisms involved in fermentation

CO6: Understand different types of fermentation

TEXT BOOKS:

1. Joshi, V. K. “Biotechnology: Food Fermentation” Volume 1. Educational Publishers & Distributors, 2004.
2. Hui Y. H “Handbook of Food and Beverage Fermentation Technology”. Marcel Dekker, 2004.
3. Wood, Brian J. B. “Microbiology of Fermented Foods” Volume 1 & 2. II Edition. Blackie Academic & Professional, 1998.

REFERENCE BOOKS:

1. Farnworth, Edward R. “Handbook of Fermented Functional Foods” II Edition. CRC Press, 2008.
2. Lea, Andrew G. H & John R. Piggott “Fermented Beverage Production” II Edition. Kluwer Academic/ Plenum Publishers, 2010

U23FTV44	BIOLOGICAL INSTRUMENTATION AND PROCESS CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Introduce the dynamic response of open and closed loop systems, control loop componentsand stability of control systems.
2. Learn instrumentation for the measurement of key process variables in food processing
3. Update the applications of sensors in food processing Industry

UNIT I OPTICAL SPECTROSCOPY 9

Design of Experiments – Error Analysis – S/N ratio – Limit of Detection – UV –VIS Spectroscopy, Applications, Instruments – single beam, double beam and Photo-diode array – applications – IR& Raman – Uses – Design – FT-IR, Raman

UNIT II CHROMATOGRAPHY 9

Distribution coefficients – solid-liquid, liquid-liquid and gas chromatography – theory of chromatography-normal phase & reverse phase chromatography – gel permeation – ion exchange & affinity chromatography – HPLC- Instrumentation & case studies

UNIT III STRUCTURAL ELUCIDATION 9

Nuclear Magnetic Resonance – Introduction-spin states – lH, 13C NMR – Instrumentation-use instructural elucidation. Electron Paramagnetic Resonance-concept & instrumentation – use in metal containing proteins & membrane studies. X-Ray : X-ray spectroscopy – Auger – EELS Instrumentation & applications in Biology- X-ray diffraction- Instrumentation – small molecule &macromolecular crystallography

UNIT IV MASS SPECTROMETRY 9

Reducing Data Complexity (Principal Component Analysis (PCA) and Exploratory Factor Analysis (EFA)), Additional Linear Model Topics (Collinearity, Logistic, Hierarchical Linear Models (HLM)), Confirmatory Factor Analysis and Structural Equation Modeling (SEM). Introduction – Instrumentation – CI, EI-Methods of Ionization- Methods for separation of Ions – Method for Detection. MALDI- TOF, ESI and FT-MS

UNIT V ELECTROCHEMICAL MEASUREMENTS 9

Different types of electrochemical apparatus – Measuring Electrode potentials- Red-Ox proteins – Porous silicon.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: To provide the students fundamentals of instrument knowledge and their applications in biology

CO2: To understand the applications of different types of chromatographic techniques

CO3: To understand about the techniques for structural elucidation

CO4: To understand the principles and methods of mass spectrometry

CO5: To understand about the electrochemical measurement types and apparatus

CO6: To learn more about the applications of instruments in food process control

TEXT BOOKS:

1. Skoog, D.A. et al., “Principles of Instrumental Analysis”. VI Edition, Thomson/Brooks/ Cole, 2007.
2. Willard, Hobart H, “Instrumental Methods of Analysis”. VII Edition, CBS Publishers, 2008.
3. Braun, R.D. “Introduction to Instrumental Analysis”. McGraw-Hill, 1987.

U23FTV45	FOOD ALLERGENS AND TOXICOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Familiarize with hazards, and toxicity associated with food and their implications for health.
2. Know the various kinds of allergens and basis of allergic reactions
3. Familiarize with various natural toxins in food

UNIT I INTRODUCTION 9

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 FOOD ALLERGY AND SENSITIVITY 9

Chemistry of food allergens, celiac disease, food disorders associated with metabolism, lactose intolerance, and asthma

UNIT III PRINCIPLES OF TOXICOLOGY 9

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

UNIT IV DETERMINATION OF TOXICANTS IN FOOD SAMPLING 9

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 TOXICANTS FORMED DURING FOOD PROCESSING 9

Intentional direct additives, preservatives, nitrate, nitrite, and N- nitroso compound flavour enhancers, food colours, 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 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Find the hazards and the toxicity associated with food and their implications for health

CO2: Analyse the chemistry of food allergens and disorders associated with food

CO3: Assess the risk and exposure of toxins in food sampling

CO4: Determine the toxicants in foods by the qualitative and quantitative analysis

CO5: Critique the formation of toxins during post harvest processing

CO6: Critique the formation of toxins during storage

TEXT BOOKS:

1. Helferich, William and Carl K.Winter “Food Toxicology” CRC Press, 2001.
2. Alluwalia, Vikas “Food Hygiene and Toxicology” Paragon International Publishers, 2007
3. Shibamoto, Taka yuki and Leonard F.Bjeldanzes “Introduction to Food Toxicology” II Edition.Academic Press, 2009.

4. Maleki, Soheila J. A.Wesley Burks, and RickiM.Helm “Food Allergy” ASM Press, 2006

REFERENCE BOOKS:

1. Labbe, Ronald G. and Santos Garcia “Guide to Food Borne Pathogens” John Wiley & Sons, 2001. ..
2. Cliver, Dean O. and Hans P.Riemann “Food Borne Diseases” II Edition., Academic Press/Elsevier, 2002
3. Riemann, Hans P. and Dean O. Cliver “Food Borne Infections and Intoxications” III Edition., Academic Press/Elsevier, 2006.

U23FTV46	GENETIC ENGINEERING AND GENETICALLY MODIFIED FOODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To study genetically modified plants which are commercially available
2. To study transgenic animals and their engineering method
3. To understand genetically modified microorganisms and their applications in foods
4. To know about pharmaceutical applications of genetically engineered plants
5. To understand Risk and safety assessment of the GM foods and their labeling

UNIT I BASICS OF RECOMBINANT DNA TECHNOLOGY 9

Manipulation of DNA and RNA – Restriction and Modification enzymes, Design of linkers and adaptors. Characteristics of cloning and expression vectors based on plasmid and bacteriophage, Vectors for insect, yeast and mammalian system, Prokaryotic and eukaryotic host systems, Introduction of recombinant DNA in to host cells and selection methods.

UNIT II DNA LIBRARIES 9

Construction of genomic and cDNA libraries, Artificial chromosomes – BACs and YACs, Screening of DNA libraries using nucleic acid probes and antisera

UNIT III SEQUENCING AND AMPLIFICATION OF DNA 9

Maxam Gilbert's and Sanger's methods of DNA sequencing. Inverse PCR, Nested PCR, AFLPPCR, Allele specific PCR, Assembly PCR, Asymmetric PCR, Hot start PCR, inverse PCR, Colony PCR, single cell PCR, Real-time PCR/qPCR – SYBR green assay, Taqman assay, Molecular beacons. Site directed mutagenesis

UNIT IV TRANSGENIC TECHNOLOGY 9

DNA microinjection, Retroviral vectors, Transgenic animals – Knock in and knock out animals, Transgenic plants – Ti plasmid

UNIT V APPLICATIONS OF RDNA TECHNOLOGY IN FOODS 9

Genetically engineered proteins: Bovine Somatotropin in Milk; Genetically engineered bacteria: ChymosinLite beer; Tryptophan; Transgenic plants: Calgene Flavr Savr TM tomato, Monsanto Round-Up TM Ready, Ciba GeigyBasta TM resistant crops; Edible vaccines: Cholera vaccine in potatoes; Transgenic Fish: Atlantic salmon.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Better understanding of genetically modified plants, animals and modified microorganisms

CO2: Familiarize in Pharmaceutical applications of genetically engineered plants

CO3: Obtain knowledge in Risk and safety assessment of the GM foods and their label.

CO4: To know about genetically modified microorganisms

CO5: To understand the applications of GMO's in foods

CO6: To learn about the applications of RDNA in foods

1. Rees, Andy “Genetically Modifies Food: A Short Guide for the Confused”. Pluto Press, 2006.
2. Ahmed, Farid E. “Testing of Genetically Modified Organisms in Food”. Food ProductsPress, 2004.

REFERENCE BOOKS:

1. Halford, Nigel G. “Genetically Modified Crops”. Imperial College Press, 2003.

OPEN ELECTIVES

		L	T	P	C
U23FTO11	**TRANSPORT PHENOMENA IN FOOD PROCESSING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

1. To acquaint and equip the students with the principles of heat and mass transfer
2. To understand the applications in food processing.
3. To acquaint problem solving in heat and mass transfer

UNIT I CONDUCTION HEAT TRANSFER 9

Introduction to heat and mass transfer and their analogous behaviour - steady and unsteady state heat conduction - analytical and numerical solution of unsteady state heat conduction equation use of Gurnie-Lurie and Heisler Charts in solving problems on conduction heat transfer - applications in food processing including freezing and thawing of foods.

UNIT II CONVECTIVE HEAT TRANSFER 9

Convective heat transfer in food processing systems involving laminar and turbulent flow- heat transfer in boiling liquids - regimes of boiling - nucleate boiling - film boiling equation - heat transfer between fluids and solid foods - natural convection over vertical cylinders, inclined surfaces, horizontal cylinders, cylinder with axis perpendicular to flow - single sphere - banks of tubes - forced convection - boundary layer diffusion equations and convention regimes - solving numerical in forced convection.

UNIT III HEAT EXCHANGER 9

Design of heat exchanger - parallel and counter flow – types - plate heat exchanger, shell and tube type heat exchanger, scrapped surface heat exchanger and jacketed vessels - functional design of heat exchanger – solving problems on heat exchangers.

UNIT IV RADIATION HEAT TRANSFER 9

Diffused radiation - angle factor - rate of radiant loss - absorption factor method - uniform radiation - assumption for emissivity determination – Kirchhoff's law - radiation heat transfer – Plank's law black body radiation emissivity and absorptivity - radiation heat transfer coefficient - black bodies - grey bodies, combined radiation and convection heat transfer - radiation surface coefficient - applications in food processing.

UNIT V MASS TRANSFER 9

Mass transfer- molecular diffusion in gases, liquids, solids, biological solutions and suspensions - unsteady state mass transfer and mass transfer coefficients, molecular diffusion with convection and chemical reaction, diffusion of gases in porous solids and capillaries, mass transfer applications in food processing.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the principles of conductive heat and mass transfer

CO2: Understand the principles of convective heat and mass transfer

CO3: Understand the design of heat exchanger

CO4: Understand the principles of radiative heat and mass transfer

CO5: Understand the molecular diffusion with convection and chemical reaction

CO6: Understand the mass transfer applications in food processing.

TEXT BOOKS:

1. Bird R. Byron, Warren E. Stewart and Edwin N. Lightfoot. 2006. Transport Phenomena.
Wiley India Pvt. Ltd., New Delhi.
2. Earle, R.L. 1985. Unit Operations in Food Processing. Pergamon Press, UK.
3. Geankoplis J. Christie. 1999. Transport Process and Unit Operations. Third Edition, Prentice Hall of India, New Delhi.
4. McCabe L. Warren, Smith C. Jullian and Peter Harriott.1993. Unit Operations of Chemical Engineering. McGraw Hill Inc. New York.
5. Paul Singh, R. and Dennis R. Heldman. 2004. Introduction to Food Engineering. Elsevier
India Pvt. Ltd., New Delhi.
6. Sinnott, R.K.2000. Coulson and Richardson's Chemical Engineering. Volume VI. Butterworth Heinemann, New delhi

U23FTO12	FOOD QUALITY AND SAFETY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To acquaint and equip the students with the latest standards
2. To understand the food quality as well as to study HACCP protocol.
3. To understand the Non-Destructive techniques for food quality evaluation

UNIT I CRITERIA FOR QUALITY CONTROL AND HYGIENIC PRACTICES **9**

Food safety- need for quality control and safety-strategy and criteria for food safety - microbiological criteria for safety and quality-sources of micro organisms for food spoilage -food borne diseases and their control - sampling plans and criteria for microbial assessments in foods food contaminants – physical, biological and chemical contaminants-factors affecting toxicity of compounds- quality control and food safety - Process equipment and machinery auditing, consideration of risk, environmental consideration, mechanical quality control – personnel hygienic standards- preventative pest control, cleaning and disinfesting system, biological factors underlying food safety.

UNIT II NON-DESTRUCTIVE TECHNIQUES FOR FOOD QUALITY EVALUATION **9**

Machine vision system- Food image formation - acquisition –analysis-interpretation – enhancement – Determination of size, shape and colour of food products - gray and colour image processing of food –Morphological Image processing – Applications. Soft X-ray systems – principles and methods of soft X-ray generation - image formation – detection and recording of X ray image of food products– processing area - analysis techniques –Determination of internal defects in fruits and vegetables - Fundamentals of acoustic resonance system – Acoustics properties – measurement of acoustic resonance -Determination of maturity level of fruits and vegetables - Application in fruit quality evaluation.

UNIT III FOOD TRACEABILITY **9**

Traceability technologies–DNA markers for animal and plant traceability – product identification data carrier technology–condition measuring data carrier technology – quality measuring carrier technology–practical applications of data carrier technology - Data carriers for traceability –linear barcode systems– RFID–EPC system.

UNIT IV FOOD SAFETY PLANS **9**

Good Manufacturing Practices (GMP) and Standard Sanitation and Operating Procedures (SSOP) - principles – applications in food industry - hygienic plant design and sanitation - safe process design and operation – hazard analysis and critical control point (HACCP) - principles, establishment of hazards, significance and control, preparation of HACCP plan, application of HACCP in food industries.

UNIT V NATIONAL AND INTERNATIONAL STANDARDS **9**

National standards - FPO, PFA, AGMARK, BIS -International standards - ISO 9001 and ISO 22,000 standards - APEDA, CFR, Codex Alimentarius Commission Standards - impact of food safety on world trade issues.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the Non-Destructive techniques for food quality evaluation
CO2: Understand the food quality as well as to study HACCP protocol.
CO3: Understand the food safety plans
CO4: Understand the knowledge about food traceability
CO5: Understand the students with the latest national standards
CO6: Understand the students with the international standards

TEXT BOOKS:

1. David A.Shapton and Norah F. Shapton. 1991. Principles and Practices for the Safe Processing of Foods. Butterworth-Heinemann Ltd, Oxford,
2. Chesworth, N. 1997. Food Hygiene Auditing. Blackie Academic Professional, Chapman and Hall.
3. Sara Mortimore and Carol Wallace. 1997. HACCP-A practical approach. Chapman and Hall.
4. Jose M. Concon. 1988. Food Toxicology, Part-A-Principles and concepts Part B Contaminants and Additives, Marrcel Dekkar Inc. Newyork and Brazil.
5. Jacob,M. 2004. Safe Food Handling. CBS Publishers and Distributors, New Delhi.

U23FTO13	STORAGE ENGINEERING AND HANDLING OF AGRICULTURAL PRODUCTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To acquaint and equip the students with the safe storage of food materials, and
2. To acquaint the students with the design of storage structures
3. To acquaint and equip the students with the design of different material handling equipment used in the industries.

UNIT I TRADITIONAL STORAGE STRUCTURES 9

Storage of grains, biochemical changes during storage - temperature and moisture - moisture migration in stored grains - production, distribution and storage capacity - estimate models, ecology, storage factors affecting losses, storage requirements - traditional storage methods-bag and bulk storage, bins and silos, rat proof godowns and rodent control, method of stacking, preventive method, bio-engineering properties of stored products.

UNIT II MODERN STORAGE STRUCTURES 9

Modern storage structure – hermetic storage - silo design - vertical silo, flat bottom silo, squat silo, deep and shallow bin - pressure distribution in bin – Janssen's theory – Airy's theory – Rankine's theory – Coulomb's equation - design of R.C.C. silo - functional aspects - structural aspects – aeration system - requirements-design of aeration system in godown and silo - grain markets.

UNIT III CONTROLLED AND MODIFIED ATMOSPHERE STORAGE 9

Controlled and modified atmosphere of durables and perishables - preservation of fruits and vegetables - factors affecting storage life – respiration - modified atmosphere storage - gases used, facilities, construction, operation and maintenance - effect of nitrogen, oxygen and carbon dioxide on storage of perishable crops - controlled atmospheric storage - equipment - scrubber - gas generation devices - controlling devices - membrane storages - diffusion channel technique for storing perishables - cold storage of fruits and vegetables - design of cold storages - concept of cold chain – construction and operation of cold storage system.

UNIT IV IRRADIATION AND BIS STANDARDS 9

Irradiation method of storage – dosage level – equipment - aeration – systems and requirements – climatograph and deterioration index - storage of dehydrated products, food spoilage and preservation – quality analysis of storied products - BIS standards on practices, equipment and design of storage structure and system.

UNITV MATERIAL HANDLING EQUIPMENTS 9

Physical factors influencing flow characteristics, mechanics of bulk solids, flow through hoppers, openings and ducts; design of belt, chain, screw, roller, pneumatic conveyors and bucket elevators; principles of fluidization; recent advances in handling of food materials – estimation of energy requirement, damage to the products during mechanical handling – operation and maintenance of conveying equipment.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO1:** Understand the safe storage of food materials
- **CO2:** Understand the design of modern storage structures
- **CO3:** Understand the design of different material handling equipment used in the industries.
- **CO4:** Understand the Irradiation and BIS standards on practices and equipment
- **CO5:** Understand the traditional storage design and structures
- **CO6:** Understand the controlled and modified atmosphere storage

TEXT BOOKS:

1. Bala,B.K. 1998. Drying and Storage of Cereal grains. Oxford and IBH Publishing Co., New Delhi
2. FAO. 1984. Design and Operation of Cold Stores in Developing Countries. FAO, Rome.
3. Hall, C.W. 1970. Handling and Storage of Food Grains in Tropical and Sub-tropical Areas. FAO Publ. Oxford and IBH. New Delhi
4. Henderson, S. and Perry, S.M. 1976. Agricultural Process Engineering
5. Ripp, B.E. 1984. Controlled Atmosphere and Fumigation in Grain Storage. Elsevier, London. 8. 9.
6. McFarlane Ian. 1983. Automatic Control of Food Manufacturing Processes. Applied Science Publ. London.
7. Multon, J.L. (Ed). 1989. Preservation and Storage of Grains, Seeds and their Byproducts. CBS., New Delhi.
8. Shefelt, R.L. and Prussi, S.E. 1992. Post Harvest Handling – A System Approach. Academic Press
9. Shejbal J. (Ed). 1980. Controlled Atmosphere Storage of Grains. Elsevier, London.
10. Vijayaraghavan, S. 1993. Grain Storage Engineering and Technology. Batra Book Service, New Delhi

U23FTO14	FUNDAMENTALS OF FOOD PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To provide basics of food system
2. To know about food process equipment's
3. To understand food spoilage and preservation.
4. To explain methods of preservation by heat and drying methods
5. equip knowledge and understand chemical and non-thermal methods of preservation

UNIT I INTRODUCTION TO FOOD SYSTEM 9

Nutrients: Sources and functions; Food groups: classification and imp01tance; Metabolism - Digestion, absorption, BMR; Body surface area and factors affecting BMR. Water intake and losses; Diet: balanced diet, recommended dietary allowances; Malnutrition

UNIT II FOOD PROCESS EQUIPMENTS 9

Dryers- theory, equipment (Rotary dryer, tunnel dryer)- centrifuge- mechanism, types, application Crystallizer- theory, types, application- Filtration-theory-equipment-application.

UNIT III INTRODUCTION TO PRESERVATION 9

Sources, types and perishability of foods: Causes and types of food spoilage; Scope and benefit of food preservation, Methods of food preservation: Preservation by salt and sugar: Principle, method and effect on food quality.

UNIT IV PRESERVATION BY HEAT AND DRYING 9

Preservation by heat treatment: Principle and equipment for blanching, canning, pasteurization, Sterilization, Preservation by use of low temperature: Principle, methods, equipment. Preservation by drying, dehydration and concentration: Principle, methods, equipment, Preservation by irradiation: Principle, methods, equipment.

UNITV PRESERVATION BY CHEMICALS AND NON-THERMAL PRESERVATION 9

Preservation by chemicals- antioxidants, mold inhibitors, antibodies, acidulants, Hurdle technology etc., Preservation by fermentation: Principles, methods, equipment Non thermal preservation processes: ·Principles, equipment -Pulsed electric field and pulsed intense . light,_ ultrasound, dielectric heating, ohmic and infrared heating, high pressure processing, microwave processing, e.tc.; Quality tests and shelf-life of preserved foods

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

- **CO1:** Understand the basic concepts of preprocessing of operations
- **CO2:** Know the technology of extracting sugarcane juice
- **CO3:** Understand the basic concepts of cane juice clarification and filtration
- **CO4:** Understand the basic concepts of cane juice clarification and filtration
- **CO5:** Acquire knowledge on modeling of evaporation process in cane sugar industry
- **CO6:** Develop techniques for cane sugar polishing

TEXT BOOKS:

1. P. Fellows, 2000. Food Processing Technology: Principles and Practice 2nd Ed. CRC Press, oca Raton FL, USA., 2. Nonnan N. Potter and Joseph H.
2. Hotchkiss. 1995. Food Science, 5" Ed. Chapman & Hall, NY,USA

REFERENCES

1. N. Sh.akuntala Manay; Foods Facts and Principles, new age international publishers,] January2008.
2. M. Shafiur Rahman. 2007. Handbook of Food Preservation; 2" Ed. CRC Press, Boca Raton, FL, USA. 3. Nonnan W. Desrosier and James N. Desrosier. 1977. The Technology of Food Preservation,4th Ed. A VI Publishing Co., Connecticut, USA.

U23FTO15	AGRI BUSINESS MANAGEMENT AND RETAIL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

1. To learn agribusiness structure, importance, and market linkages
2. To understand export policies, pricing, and financial management in agribusiness.
3. To explore small-scale agribusiness development and retailing strategies
4. To learn retail management, planning, and strategic operations
5. To develop skills in retail organization, communication, and leadership.

UNIT I INTRODUCTION ON AGRIBUSINESS AND MARKETING 9

Introduction: Definition, Structure, Features of agribusiness, Importance of agribusiness, Scope for agribusiness, Role of agriculture in Indian economy, Linkages among sub Marketing and distribution in Agribusiness: Marketing of agriculture inputs, models and theories of agricultural marketing, Characteristics of production, consumption and marketable surplus of agribusiness in India. Distribution management – storage, warehousing and transportation management of agricultural products; marketing agencies/intermediaries

UNIT II EXPORT AND FINANCIAL IN AGRIBUSINESS 9

Export in Agribusiness: objectives of pricing policies, Marketing policies and practice for agribusiness - determinants of price, Export of Agro products: legal requirements, steps and issues, Selection of market and channels of Export. Financial in Agribusiness: Assessment of financial requirement of agribusiness unit, Working capital management - concept and components of working capital, need for working capital in agribusiness, inventory for agribusiness. agribusiness financing systems - functioning of cooperative credit institutions, commercial banks, regional rural banks, NABARD.

UNIT III SMALL SCALE AGRIBUSINESS AND RETAILING 9

Small scale Agribusiness: Small Scale Industry in Indian Economy, Development: definition, importance, growth stages, and entrepreneurial opportunities in modern agriculture. Overview of retailing: Concept of retailing, importance of developing and applying retail strategy, strategic options for retailers, types of retail markets, Forms of retailing: direct marketing, electronic retailing, Retailing implications of consumer demographics and lifestyles, consumer decision making process..

UNIT IV RETAIL MANAGEMENT AND PLANNING 9

Retail Management and Planning: Retail management: definition, importance and elements, functions of retail manager, Retail planning: definition, characteristics, importance, classification of retail planning, steps in planning, identification of consumer characteristics and needs, Considerations in planning retail strategy mix, food-oriented retailers. Managing retail business: Setting up retail organization, Strategic Profit model of asset management, blueprint of retail business operation

UNITV RETAIL ORGANIZATION AND DIRECTING 9

Retail Organization and Directing: Organization- definition, characteristics, importance, steps in retail organization process, Directing: Supervision, leadership, functions of leader, types of communication, Nature of communication.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students would be able to

CO1: Outline the importance of agribusiness industry, working of retailing works and factors influencing it

CO2: Summarize the contribution of small scale agri-industry and sustainable competitive advantage through optimization of available resources

CO3: Plan and identifying more insight about consumer buying segment

CO4: Make use of good communication, team-building, leadership and applied management skills to develop a business

CO5:	Develop management skills relevant for human capital use and plan merchandise presentation to influence customer‘s buying decision

TEXT BOOKS:

1. David Van Fleet, Ella Van Fleet & George J. Seperich, "Agribusiness: Principles of Management", 1st Edition, Cengage Learning, USA, 2013.
2. Barton A Weitz, Dhruv Grewal & Micheal Levy, "Retailing Management", 9th Edition, McGraw-Hill Education, New Delhi, 2013.
3. Barry R. Berman, Joel R. Evans & Patrali M. Chatterjee, "Retail Management", 13th Edition, Pearson Education Limited, UK, 2017.
4. Jay T. Akridge, Freddie Barnard & Frank J. Dooley, "Agribusiness Management", 4th Edition, Routledge, New York, 2012.

U23FTO22	NUTRACEUTICALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the basic concepts of Nutraceuticals and functional food, their chemical nature and methods of extraction
2. To understand the role of Nutraceuticals and functional food in health and disease.

UNIT I INTRODUCTION 9

Introduction to Nutraceuticals and functional foods; importance, history, definition, classification, list of functional foods and their benefits, Phytochemicals, zoo chemicals and microbes in food, plants, animals and microbes.

UNIT II MANUFACTURING OF NUTRACEUTICALS 9

Phytoestrogens in plants; isoflavones; flavonols, polyphenols, tannins, saponins, lignans, lycopene, chitin, caratenoids. Manufacturing practice of selected nutraceuticals such as lycopene, iso flavonoids, glucosamine, phytosterols. Formulation of functional foods containing nutraceuticals - stability, analytical and labelling issues.

UNIT III IN VITRO AND IN VIVO METHODS 9

In vitro and in vivo methods for the assessment of antioxidant activity, Comparison of different *in vitro* methods to evaluate the antioxidant, antioxidant mechanism, Prediction of the antioxidant activity of natural phenolics from electrotopological state indices, Optimising phytochemical release by process technology; Variation of Antioxidant Activity during technological treatments, new food grade peptidases from plant sources.

UNIT IV NUTRACEUTICALS FOR HEALTH 9

The health benefit of - Soy protein, Spirulina, Tea, Olive oil, plant sterols, Broccoli, omega3 fatty acid and eicosanoids. Nutraceuticals and Functional foods in Gastrointestinal disorder, Cancer, CVD, Diabetic Mellitus, HIV and Dental disease; Importance and function of probiotic, prebiotic and symbiotic and their applications, Functional foods and immune competence; role and use in obesity and nervous system disorders.

UNIT V HEALTH CLAIMS 9

Health Claims, Adverse effects and toxicity of nutraceuticals, regulations and safety issues International and national.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Understand the basic concepts, chemical nature and methods of extraction of nutraceuticals and functional foods

CO2: Understand the role of nutraceuticals in health and diseases

CO3: Understand the regulatory framework for nutraceuticals.

CO4: Critically evaluate research on nutraceuticals.

CO5: Communicate effectively about nutraceuticals to consumers and healthcare professionals

CO6: Define nutraceuticals and explain their role in health and wellness.

TEXT BOOKS:

1. Bisset, Normal Grainger and Max Wich H “Herbal Drugs and Phytopharmaceuticals”, 2nd Edition, CRC, 2001.
2. Handbook of Nutraceuticals and Functional Foods: Robert Wildman, CRC, Publications. 2006
3. WEBB, PP, Dietary Supplements and Functional Foods Blackwell Publishing Ltd (UnitedKingdom), 2006

4. Ikan, Raphael “Natural Products: A Laboratory Guide”, 2nd Edition, Academic Press / Elsevier,2005.

REFERENCE BOOKS:

1. Asian Functional Foods (Nutraceutical Science and Technology) by John Shi (Editor), FereidoonShahidi (Editor), Chi-Tang Ho (Editor), CRC Publications, Taylor & Francis, 2007
2. Functional Foods and Nutraceuticals in Cancer Prevention by Ronald Ross Watson (Author),Blackwell Publishing, 2007

U23FTO23	INNOVATIVE PACKAGING OF DAIRY PRODUCTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the principles of packaging and its role in protecting, preserving, and marketing dairy products.
2. To learn about the different types of packaging materials used for dairy products, as well as the factors that need to be considered when choosing a packaging material.
3. To explore the latest trends in innovative packaging for dairy products, with a focus on food safety and sustainability.
4. To develop the skills necessary to design and develop innovative packaging solutions for dairy products.

UNIT I INTRODUCTION **9**

Importance of Packaging, History of Package Development, Packaging materials, Characteristics of basic packaging materials: Paper (paper board, corrugated paper, fibre board), Glass, Metal, Plastics, Foils and laminates, retort pouches, Package forms, Legal requirements of packaging materials and product information

UNIT II PACKAGING MATERIALS TESTING **9**

Working principles of various type batch type filling machine, working principles of FFS machine, Identification of packaging materials; Flame Hot wire test, Testing of papers/ paperboards: Percentage moisture, Grease resistance, Water absorptiveness, Grammage, Tearing resistance, Bursting strength, Testing of glass bottle – resistance to thermal shock, Testing of plastics and laminates – Thickness, Water vapour transmission rate (WVTR), Grease resistance

UNIT III PACKAGING OF MILK AND DAIRY PRODUCTS **9**

Packaging of milk and dairy products such as pasteurized milk, UHT-sterilized milk, aseptic packaging, fat rich products-ghee and butter, coagulated and desiccated indigenous dairy products and their sweets, concentrated and dried milks including baby foods. Packaging of functional dairy/food products.

UNIT IV MODERN PACKAGING TECHNIQUES FOR FOOD SAFETY AND SUSTAINABILITY **9**

Modern Packaging Techniques; Vacuum Packaging, Modified atmosphere packaging (MAP), Eco-friendly packaging, Principles and methods of package sterilization, Coding and Labelling of Food packages, Aseptic Packaging (AP), Scope of AP and pre-requisite conditions for AP, Description of equipment (including aseptic tank) and machines- Micro-processor controlled systems employed for AP, Package conditions and quality assurance aspects of AP

UNIT V MICROBIOLOGICAL AND ENVIRONMENTAL ASPECTS OF PACKAGING MATERIALS **9**

Microbiological aspects of packaging materials. Disposal of waste package materials, Packaging Systems. Hazards from packaging materials in food

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Explain the principles of packaging and its role in protecting, preserving, and marketing dairy products.

CO2: Identify the different types of packaging materials used for dairy products, and the factors that need to be considered when choosing a packaging material.

CO3: Discuss the latest trends in innovative packaging for dairy products, with a focus on food safety and sustainability.

CO4: Design and develop innovative packaging solutions for dairy products.

CO5: Analyse the economic and environmental impact of different packaging materials and solutions.

CO6: Communicate effectively about innovative packaging solutions to stakeholders.

TEXT BOOKS:

1. Ahvenainen, R. (2003). Novel Food Packaging Techniques. Woodhead Publ. Ltd., Cambridge, England.
2. Engineers India Research Institute. (2005). Handbook of Packaging Technology. EIRI, Delhi.

REFERENCE BOOKS:

1. Han, J. (2005). Innovations in Food Packaging. Elsevier Science & Technology Books.
2. Yam, K. L. (2009). Encyclopedia of Packaging Technology. 3rded. John Wiley and Sons, Inc. Publ., USA.

U23FTO24	TECHNOLOGY OF FOOD COLOURS AND FLAVOURS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the basics of food flavors and colors.
2. To explore technology and sources of food colors
3. To study the production and application of plant-based flavors.
4. To learn methods for analyzing flavors and colors.
5. To apply flavors and colors in food product development

UNIT I BASICS OF FOOD FLAVOURS AND BASICS OF FOOD COLOURS **9**

Introduction, classification of food flavors, perception of flavor and taste–Theories of olfaction - Molecular structure and activity relationships of taste – sweet, bitter, acid and salt, Chemicals causing pungency, astringency, cooling effect – properties. Regulations regarding additions, toxicology and safety aspects of food flavor. Introduction, classification of food colours, perception of colour, basics of colour – hue, chroma, brightness, saturation. Regulations regarding additions, toxicology and safety aspects of food colours.

UNIT II ORIGIN OF FOOD COLOURS AND TECHNOLOGY OF FOOD COLOURS **9**

Plant - Chlorophyll and chlorophyll derivatives, carotenoids, annatto, saffron, turmeric, Caramel colour, anthocyanins and betalains. Animal- Haems and bilins , monascus, cochineal and related pigments. Synthetic -Forms and types, certified F,D and C colourants. Technology for the production of dried colorants, stability - pH, temperature and other processing conditions. Role of micro organism in synthesis of food colours, encapsulated food colourants

UNIT III FOOD FLAVOURS FROM PLANT ORIGIN AND FLAVOURS EVOLUTION **9**

Alliaceous flavours, bittering agents, coffee and cocoa, fruit flavours. Enzymatic development, effect of roasting, cooking, frying on flavour developments Essential oils and oleoresins – extraction methods. Liquid and dry flavour production, encapsulated flavours, microbial synthesis of flavours, flavour enhancer and seasonings. factors affecting stability of flavours

UNIT IV FLAVOUR ANALYSIS AND COLOUR ANALYSIS **9**

Aroma Compounds - Sample Selection/Preparation, Principles of Aroma Isolation – Solubility, Sorptive Extraction, Volatility. Methods of Aroma Isolation – Static Headspace, Headspace Concentration Methods (Dynamic Headspace)- Distillation Methods – Solvent Extraction, Sorptive Extraction - Concentration for Analysis, Aroma Isolation, Prefractionation - Gas Chromatography, GC/Olfactometry (GC/O) GC- MS/Olfactometry (GC-MS/O), Mass Spectrometry. Preparation and isolation of sample, spectrophotometry, colorimetry, Hunter Colour lab, CIE system, Lovibond Tintometer, Munsell colour system.

UNIT V FLAVOURANTS APPLICATIONS IN FOOD AND COLOURANTS APPLICATIONS IN FOOD **9**

Soups and stocks, sauces, seasonings, and marinades, baked goods and bakery products, snack foods, sugar based confectionery products and chewing gum, dairy Products - flavoured milks, flavoured yogurts, flavoured dairy desserts. Beverages, dairy products, confections, baked products and other foods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, students will be able to:

CO1: Summarize the basic concepts related to flavours and colours.

CO2: Apply the technological aspects of colours in food product development

CO3: Apply the technological aspects of flavours in food product development.

CO4: Examine the techniques involved in analysis of flavor and color

CO5: Select and apply appropriate flavours and colours for different food products

TEXT BOOKS:

1. Reineccius G. and Heath H.B., "Flavor Chemistry and Technology", 2nd Edition, CRC Press, 2006
2. Carmen Socaciu., "Food Colorants: Chemical and Functional Proerties",1st Edition, CRC Press, 2008.

REFERENCE BOOKS:

1. Rowe D.J., "Chemistry and Technology of Flavors and Fragrances", 1st Edition, Blackwell Publishing Ltd., 2005.
2. NIIR board., "Food Colours, Flavours and Additives Technology Handbook, 1st Edition, National Institute of Industrial Research, 2004.

U23FTO31	NANO TECHNOLOGY IN FOOD SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Learn about the emerging field of nanotechnology and its application in food systems.
2. Able to learn about characterization of nanomaterials
3. Acquire knowledge on the concept of nanocomposites
4. Learn concept of the toxicology of nanomaterials
5. Develop knowledge on nanotechnology for food packaging

UNIT I INTRODUCTION 9

Nanomaterials - Definition - History - Properties - Optical - Electrical - Mechanical - Magnetic - Semiconductor nanoparticles (Quantum dots) - Synthesis of Nanomaterials - Top-down Approach - Bottom-up Approach - Applications of Nanotechnology.

UNIT II CHARACTERIZATION OF NANOMATERIALS 9

X-ray Diffraction (XRD),UV-Vis Spectroscopy - Infra-red (IR) - Atomic Force Microscopy (AFM), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Energy Dispersive X-ray Analysis (EDX).

UNIT III NANOCOMPOSITES IN FOOD 9

Food Nanotechnology: Current developments and future prospects; Definition of Nanocomposites – Formation of Nanocomposites - Polymer Nanocomposites - Bio-based Nanocomposites - Starch – Pectin – Cellulose – Polylactic acid - Protein Nanocomposites.

UNIT IV NANOTECHNOLOGY FOR FOOD PACKAGING 9

Nanotechnology and applications in food safety; Nanotechnology for food: delivery system; Nanostructured encapsulation systems: food antimicrobials; Barrier Packaging – Antimicrobial Packaging- Antimycotic Packaging- Bio-based Packaging- Bio-degradable Packaging- Active Packaging – Smart Packaging

UNIT V TOXICOLOGY OF NANOMATERIALS IN FOOD 9

Engineering of Nanomaterials for Food - Issues in Characterization of Engineered Nanomaterials - Safety of Nanomaterials in Food – Toxicokinetic – Absorption- Distribution – Metabolism – Excretion - Toxicology Studies – In Vivo toxicity – In Vitro Toxicity - Reliability of the study.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Understand the concept of nanocomposites
CO2: Understand the toxicology of nanomaterials
CO3: Acquire knowledge on nanotechnology for food packaging
CO4: Understand about the characterization of nanomaterials
CO5: Acquire knowledge on the applications of nanomaterials
CO6: Develop knowledge on emerging field in food nanotechnology.

TEXT BOOKS:

1. Nanostructures and Nanomaterials: Synthesis, Properties and applications, by Guozhong Cao, 2004 Imperial College Press, London
2. Nano: The essentials: Understanding Nanoscience and Nanotechnology - T. Pradeep - 2009 – Tata Mc Graw Hill.
3. The Chemistry of Nanomaterials - C.N. Rao, A. Müller, A. K. Cheetham 2005 Wiley-VCH.

REFERENCE BOOKS:

1. Nanotechnology in the Agri-Food Sector: Implications for the Future - L.J. Frewer, W. Norde, A. Fischer and F. Kampers, 2011 Wiley-VCH.
2. Nanotechnology Research Methods for Food and Bioproducts – G. W. Padua and Q. Wang, 2012 John Wiley and Sons.
3. Global Issues in Food Science and Technology- Gustavo V. Barbosa-Canovas, Alan Mortimer, David Lineback, Walter Spiess, Ken Buckle, Paul Colonna, Academic Press.
4. Starch – Based Polymeric Materials and Nanocomposites: Chemistry, Processing and Applications- Jasim Ahmed, Brijesh K. Tiwari, Syed H. Imam, M. A. Rao, CRC press

U23FTO33	TRADITIONAL FOODS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To understand the historical and traditional perspective of foods and food habits
2. To provide students with knowledge about the various types production process of traditional foods.
3. To help the learners to packed traditional beverages and fermented food production.
4. To provide students with a elaborate the health aspects of traditional food
5. To understand the wide diversity and common features of traditional Indian foods and meal patterns

UNIT I HISTORICAL AND CULTURAL PERSPECTIVES 9

Introduction to traditional food, Food culture: Geographical features and food scope and Importance of food in understanding human culture - variability, diversity, from basic ingredients to food preparation; impact of customs and traditions on food habits, festive occasions, specific religious festivals, mourning; Kosher, Halal foods. Tradition and modern method comparisons- energy costs, efficiency, yield, shelf life and nutrient content. Commercial food products and South Indian food

UNIT II TRADITIONAL METHODS OF FOOD PROCESSING 9

Traditional methods of milling grains – rice, wheat and corn – equipment and processes as compared to modern methods. Ghani: A traditional method of oil processing. Paneer, butter and ghee manufacture – comparison of traditional and modern methods. Traditional Equipment used for Cooking – Chakki, Cuhula, Degchis, Earthenware pots, kadhai, Tandoor. Traditional methods of food preservation – sun-drying, osmotic drying, brining, pickling- vegetables fish and meat, smoking- dry fish, Temp, soya sauce and vegetable fermented products

UNIT III HEALTH ASPECTS OF TRADITIONAL FOODS 9

Typical breakfast, meal and snack foods of different regions of India. Regional foods that have gone Pan Indian / Global. Popular regional foods; Traditional fermented foods, pickles and preserves, beverages, snacks, desserts and sweets, street foods; IPR issues in traditional foods.

UNIT IV HEALTH ASPECTS OF TRADITIONAL FOODS 9

Comparison of traditional foods with typical fast foods/ junk foods-cost ,food safety, Nutrient composition, bioactive component; energy and environmental costs of traditional foods; processing procedures to reduce losses of Nutrients, Traditional foods used for specific ailments /illnesses

UNIT V TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS 9

Formulation production and processing of Authentic traditional Indian sweet and snack, Adirasam, Mysore pak, Khajoor, Petha, Jelabis, Jamun, Rasgolla, formulation and preparation of Namkeen, Muruku, traditional breads Ready-to-eat foods and instant mixes, frozen foods. Commercial production of intermediate foods – ginger and garlic pastes, tamarind pastes, masala (spice mixes), Idli and dosa batters. Traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Recall about cultural perspectives, basic ingredient for food preparation and

impact of traditional food.

CO2: Knowledge in Methods and production process of food preservation and Traditional foods.

CO3: Knowledge on traditional food patterns and fermented foods.

CO4: Assess and commercial the concept of packed traditional beverages, food production

CO5: Learn about health aspects of traditional food and used for specific ailments /illnesses

TEXT BOOKS:

1. Sen, Colleen Taylor "Food Culture in India" Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes: East West Books, 2001.

REFERENCE BOOK:

1. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
2. Aneja. R.P, Mathur.BN, R.C. Chandan,andBanerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.
3. Gibson, R. Principles of Nutritional Assessment. Oxford University Press, N.Y. 1990
4. Gilbert, J. Preserving flowers and fruit in spirit. From "New Zealan Gardener" December, 1971.

U23FTO34	NUTRITION AND HEALTHY LIFE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. To learn nutritional disorder
2. To learn the concept of disease management
3. To impart knowledge on nutritional requirements of exercise
4. Knowledge about healthy life style and fitness.

UNIT I FOOD GROUPS AND OVERVIEW OF NUTRITION 9

Introduction to food science, Major food groups and their classification, Balanced diets, Recommended Dietary Allowances (RDA) for all age groups. Planning a healthy diet, BMR and BMI calculations. Nutritional requirements of carbohydrates, protein and fats; Water - recommended intakes; fluid/electrolyte balance.

UNIT II NUTRITIONAL DISORDERS 9

Types - anemia, Malnutrition: Kwashiorkor and Marasmus, obesity, vitamin and major mineral deficiency – diagnosing – long term effect; treatment – oral and Parenteral Administration. Dietary changes.

UNIT III DIET FOR DISEASES I 9

Etiology, symptoms, classification - short term and long term complications - prevention, monitoring criteria and management of various diseases - Cardiovascular disease - Diabetes - Diseases of Liver, Gall bladder & Pancreas - Renal disease

UNIT IV DIET FOR DISEASES II 9

Complication and management of Gastrointestinal diseases/disorders - Gastritis and Peptic ulcer - Crohn's disease, diarrhea, constipation, ulcerative colitis. Diagnosis, Nutrition in the etiology of cancer, Nutritional implications of cancer therapy.

UNIT V NUTRITION AND PHYSICAL FITNESS 9

Exercise and Fitness- Definition, benefits, components and indicators of fitness. Nutritional requirements for exercise - body adaptation – energy need - macronutrient, fluids, vitamins and minerals requirement. Alternative health and fitness –yoga and meditation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course the students would be able to

CO1: Pronounce major types of food groups, balanced diet and RDA requirement for all age

CO2: Illustrate the concept and types of management of nutritional disorder

CO3: Explicit the complication and symptoms of CVD, diabetes and liver

CO4: Remember the complication and management of gastrointestinal diseases

CO5: Recall the importance, benefits and nutritional requirements of exercise and fitness

TEXT BOOKS:

1. Srilakshmi B., "Nutrition Science", 3rd Edition, New Age International Ltd., New Delhi, 2011.

2. Sharda Gupta, Santosh Jain Passi, Rama Seth, Ranjana Mahna & Seema Puri Kumud Khanna "Textbook of Nutrition and Dietetics" 2nd edition, 2014

REFERENCE BOOK:

1. Gopalan C., B.V. Rama Sastri, and S.C. Balasubramanian S. C. “Nutritive Value of Indian Foods”. NIN, ICMR, 2004.
2. 2 Damodaran, S., K.L. Parkin and O.R. Fennema. “Fennema‟s Food Chemistry”. 4th Edition, CRC Press, 2008
3. 3 Belitz,H.-D, Grosch W and Schieberle P. “Food Chemistry”, 3rd Rev. Edition, Springer- Verlag, 2004.
4. 4 Walstra, P. “ Physical Chemistry of Foods”. Marcel Dekker Inc. 2003.

U23FTO35	FOOD INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The main learning objective of this course is to prepare the students for:

1. Impart knowledge on structural interaction between organic molecules and their interaction.
2. Provide a knowledge about the various types of sequence database
3. Impart knowledge on both *Insilco* and *Invitro* studies
4. Gain knowledge on determination of structure of molecules
5. Learn bioinformatics tools

UNIT I INTRODUCTION 9

Role of functional foods against metabolic syndrome like diabetics, celiac diseases. Potential benefits (like antioxidant, anticancer activity) of active compounds present in the food materials (herbs, fruits, & vegetables) – proteins and phytochemicals like – Carotenoids, Lycopene, Xanthophylls, lutein, Sulfides, Polyphenolics, Flavonoids, Naringin, Quercetin, Anthocyanidins, catechins, Flavones, Prebiotics / Probiotics, Fructo oligosaccharides, Lactobacillus, Phytoestrogens: Isoflavones, daidzein, Geebustin, lignans, Tocopherols, etc.

UNIT II SEQUENCE DATABASE 9

Introduction to bioinformatics tools: Sequence database – Nucleotide, protein, Literature Databases, Composite Databases (NRDB), Genome Databases- (Viral genome database (ICTV db)), Bacterial Genome database (GOLD, MBGD), Organism specific database. file formats, Introduction to sequence alignment (only general ideas, not algorithm) - Local and global, pair wise and multiple, BLAST. Small compound database – PubChem, ChemSpider, ZINC, ChEMBl, Drug Bank, Flavornet (Volatile compounds form the literature based on GC-MS), Super Sweet (Database-Carbohydrates & artificial sweeteners).

UNIT III STRUCTURE PREDICTION 9

Extraction of active compounds from food materials. Screening of active molecules using chromatography techniques. Chemsketch – conversion of 2-D structure into 3D structure. X- ray crystallography & NMR techniques: Protein 3D structure, Collecting X-ray Data, Diffraction, Coordinate systems in crystallography, Electron Density maps, obtaining a model, Judging the molecular models, other diffraction methods for model building, Tools for studying macromolecules.

UNIT IV IN Silico Models 9

Introduction to Molecular docking, Structure Based methods to identify lead components, Energy minimization tool, Denovo ligand design, molecular docking and molecular simulation case studies

UNIT V INVITRO Models 9

Introduction – preparation of cell culture media and its requirements. Preservation cell line cultures-cryopreservation. Facts of cell line contamination; cell line studies: Anti-diabetic, Anti-Cancer, and Anti-inflammation activity. cytotoxicity by MTS assay. Case studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Understand the facts and importance's of phytochemicals.

CO2: Evaluate the structural prediction and refinement of organic molecules.

CO3: Able to discuss about the various types of sequence database

CO4: Apply the fundamental conceptual of *In-silico* methods

CO5: Apply the fundamental conceptual of Invitro methods

CO6: Apply the knowledge of bioinformatics to find the sequence data base

TEXT BOOKS:

1. Food informatics: Applications of Chemical Information to Food Chemistry. (2014). Germany: Springer International Publishing.
2. Bioinformatics: Sequence and Genome Analysis by Mount D., Cold Spring Harbor Laboratory Press, New York. 2004
3. Arthur K. Lesk, “Introduction to Bioinformatics”, Oxford University Press, 4th edition, 2014.