Course Curriculum of First Semester

as per the ICAR-Sixth Deans' Committee Report for the Academic Programmes in

FOOD TECHNOLOGY

- UG-Certificate in Food Technology
- UG-Diploma in Food Technology
- UG-Degree: B.Tech. (Food Technology)

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DICC - UG Degree Syllabus Core Committee

Submitted to the

Directors of Instruction Coordination Committee

~ w.e.f. AY, 2024-25 ~

Course Layout

B.Tech. (Food Technology)

Semester: I (New) ***w.e.f.*** **Academic Year: 2024-25**

Sr. No.	Course No.	Course Title	Credit Hrs.	Remark
1.	**CAC-111**	*Deeksharambh* (Induction-cum-Foundation Course)	2(0+2)	NG (2 Weeks)
2.	**AEC-111**	National Service Scheme (NSS-I) / National Cadet Corps (NCC-I)	1(0+1)	
3.	**AEC-112**	Communication Skills	2(1+1)	
4.	**MDC-111**	Farming-based Livelihood Systems	3(2+1)	
5.	**MATH-111*/ BOT-111****	Basic Mathematics*/ Basic Botany**	2(2+0)	NG & Need-based
6.	**FT-111**	Fundamentals of Food Processing	3(2+1)	
7.	**FQA-111**	Food Chemistry-I	3(2+1)	
8.	**FQA-112**	General Microbiology	3(2+1)	
9.	**FE-111**	Post Harvest Engineering	3(2+1)	
10.	**SEC-111**	Skill Enhancement Course-I *(To be offered from the bouquet of SEC Courses)*	2(0+2)	
11.	**SEC-112**	Skill Enhancement Course-II *(To be offered from the bouquet of SEC Courses)*	2(0+2)	
		Total Credits Hrs.	**22(11+11) G 4(2+2) NG**	

CAC: Common Academic Course, AEC: Ability Enhancement Course, MDC: Multidisciplinary Course, SEC: Skill Enhancement Course, G: Gradial, NG: Non-Gradial

Note: *MATH-111 for PCB student/ **BOT-111 for PCM student/ PCMB student is NOT required to take any of these Need-based Courses.

Course-wise Syllabus with Teaching Schedules

Semester	**:**	**I**	
Course No.	**:**	**CAC-111**	**Credit Hrs. : 2 (0+2) NG/ 2 Weeks**
Course Title	**:**	***Deeksharambh* (Induction-cum-Foundation Course)**	
Non-Gradial Common Academic Course for the said UG degree with the activities to be conducted during initial two weeks.			

Objectives:

(i) To create a platform for students to help for Cultural Integration of students from different backgrounds,

(ii) To know about the operational framework of academic process in the University, instilling life and social skills,

(iii) To create Social awareness, Ethics and Values, Team work, Leadership, Creativity,

(iv) To identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

ACTIVITIES

- Introduction/Orientation and Discussions on operational framework of academic process in University/ College, as well as interactions with Academic and Research Managers of the University.
- Interaction with Alumni, Business Leaders, Perspective Employers, Outstanding Achievers in related fields and people with inspiring life experiences.
- Students shall be made aware about the field of food processing, the industry, production, systems, importance of nutrition, packaging, quality issues involved, shelf life and the legal standards available using simple day-to-day example.
- Students shall be exposed to the job opportunities at various levels like production, product development, entrepreneurship opportunities and research opportunities that exist in this area of food processing technology.
- Group activities to identify the strength and weakness of students and to learn from each other's life experiences.
- Activities to enhance Cultural Integration of students from different backgrounds.
- Field visits to the relevant fields/ establishments.
- Sessions on Personally Development (Instilling Life and Social skills, Social awareness, Ethics and Values, Team work, Leadership etc.) and imbibing the Communication skills.

Note: *The details of the relevant activities will be decided by the parent University in line with the above-mentioned broad activities.*

Semester : I		
Course No. : AEC-111	**Credit Hrs. : 1(0+1)**	
Course Title : National Service Scheme (NSS-I) / National Cadet Corps (NCC-I)		
Gradial Common Course across all UG degrees		

Course No.: AEC-111	**Course Title: National Service Scheme-I (NSS-I)**	**Credit Hrs.: 1(0+1)**

SYLLABUS

PRACTICAL

Introduction and Basic Components of NSS

- Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
- Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
- NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, Conducting survey, Analysing Guiding financial patterns of scheme, Youth program/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth; and Opportunities for youth who is agent of the social change.
- Community mobilization. Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership. Social harmony and National integration.
- Indian history and culture, role of youth in nation building, Conflict resolution and peace building. Volunteerism and Shramdaan. Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.
- Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information. Family and Society. Concept of family, Community (PRIs and other community-based organizations) and Society.

TEACHING SCHEDULE

PRACTICAL [AEC-111]

Exercise No.	Exercise Topic	Weightage (%)
1	Orientation, History, Objectives, Principles, Symbols, Badge	10
2	Regular Programmes under NSS	10
3	Organisational Structure of NSS	10
4	Code of Conduct of NSS Volunteer	10
5	Points to be considered about NSS Volunteers awareness about Health	5
6	NSS Programme Activities- Concept of Regular activities	5
7	NSS Programme Activities- Special Campaign	5
8	NSS Programme Activities- Day Camps	5
9	NSS Programme Activities- Adoption of village, Conducting survey, Analysing Guiding financial patterns of scheme	5
10	NSS Programme Activities- Youth programs/schemes of GOI, Coordination with different agencies and maintenance of diary. Understanding youth. Definition, Profile, Categories, Issues and Challenges of youth and Opportunities for youth who is agent of the social change.	5
11	Community Mobilization- Mapping of community stakeholders, Designing the message as per problems and their culture; Identifying methods of mobilization involving youth-adult partnership.	5
12	Community Mobilization-Culture, Social harmony and National integration.	5
13	Indian History and Culture- Role of youth in Nation Building	5
14	Volunteerism and Shramdaan: Indian tradition of volunteerism, its need, importance, motivation and constraints; Shaman as part of volunteerism.	5
15	Citizenship, Constitution and Human Rights: Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information.	5
16	Family and Society: Concept of family, Community (PRIs and other community-based organizations) and Society.	5
	Total=	**100**

Course No.: AEC-111	Course Title: National Cadet Corps-I (NCC-I)	Credit Hrs.: 1(0+1)

SYLLABUS

Objective: To integrate and develop qualities of leadership, discipline, character and patriotism and foster the NCC Motto: **"Unity and Discipline"** among the youth.

PRACTICAL

- Aims, Objectives, Organization of NCC and NCC Song. DG's Cardinals of Discipline.
- Drill- aim, General words of command, Attention, Stands-at-ease, Stand-easy and Turning.
- Sizing, Numbering, Forming in three ranks, Open and Close order march and Dressing.
- Saluting at the halt, Getting on parade, Dismissing and Falling-out.
- Marching, Length of pace and time of marching in quick/slow time and halt. Side pace, Pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
- Marking time, Forward march and halt. Changing step, Formation of squad and squad drill.
- Command and control, Organization, Badges of rank, Honours and Awards.
- Nation Building- Cultural heritage, Religions, Traditions and Customs of India. National integration. Values and ethics, Perception, Communication, Motivation, Decision making, Discipline and duties of good citizens. Leadership traits, Types of leadership. Character/ Personality development. Civil defence organization, Types of emergencies, Fire fighting, Protection. Maintenance of essential services, Disaster management, Aid during development projects.
- Basics of Social Service, Weaker sections of society and their needs, NGO's and their contribution, Contribution of youth towards Social welfare and Family planning.
- Structure and Function of human body, Diet and Exercise, Hygiene and Sanitation. Preventable diseases including AIDS, Safe blood donation, First aid, Physical and mental health. Adventure activities. Basic principles of Ecology, Environmental conservation, Pollution and its control.

TEACHING SCHEDULE

PRACTICAL [AEC-111]

Exercise No.	Exercise Topic	Exercise Sub-topics	Weightage (%)
1-2	Introduction to NCC	Aims, Objectives, NCC Organizational structure, NCC Song, DG's Cardinals of Discipline.	4
3-5	Drill Basics	Aim of drill, General words of command, Positions of attention, Stand-at-ease and Stand-easy, Turning.	8
6-8	Formation Drills	Sizing, Numbering, Forming in three ranks, Open and Close order march and Dressing.	8
9-11	Saluting Drills and Parade Movements	Saluting at halt, Getting on parade, Dismissing and Falling-out.	8
12-14	Marching Techniques	Length of pace and time of marching in Quick/slow march, Side pace, Forward/rear pace, Turning on the march, Wheeling and Saluting on the march	10
15-17	Squad Formation and Control	Marking time, Forward march, Halt, Changing step, Formation of squad and Squad drill.	10
18-19	Command and Control in NCC	Organization, Badges of rank, Honours and Awards.	4
20-22	Nation Building and Citizenship; Leadership	Cultural heritage, Religions, Traditions, Customs of India, National integration, Values and Ethics, Communication, Leadership traits, Discipline and Motivation, Character/ Personality Development.	12
23-24	Civil Defence and Emergency Management	Types of emergencies, Fire fighting techniques, Maintenance of essential services, Disaster management and Aid during development projects, Civil Defence Organizations.	10
25-26	Social Service and Youth Welfare	Weaker sections of society, Role of NGOs, Youth participation in Social welfare and Family planning	8
27-29	Health, Hygiene and First Aid	Human body structure, Diet, Hygiene, Preventable diseases (including AIDS), Safe blood donation, First aid practices, Mental and Physical health.	10
30-32	Environment and Ecology	Basic Principles of Ecology, Environmental conservation, Pollution and its control, Adventure activities.	8
		Total =	**100**

Semester	**:**	**I**			
Course No.	**:**	**AEC-112**	**Credit Hrs.**	**:**	**2(1+1)**
Course Title	**:**	**Communication Skills**			
Gradial Common Course across all UG degrees					

SYLLABUS

Objectives:(i) To acquire competence in oral, written and non-verbal communication

(ii) To develop strong personal and professional communication and

(iii) To demonstrate positive group communication.

THEORY

Communication Process: The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning, types and models of communication; Verbal and Non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication. Basic Communication Skills: Listening, Speaking, Reading and Writing Skills; Precis writing/Abstracting/Summarizing; Style of technical communication, Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions; Structural and Functional Grammar: Sentence structure, modifiers, connecting words and verbals; Phrases and clauses; Case: subjective case, possessive case, objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

PRACTICAL

Listening and note taking; Writing skills: precis writing, summarizing and abstracting; Reading and comprehension (written and oral) of general and technical articles; Micro-presentations and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; Vocabulary building exercises; Interview techniques; Organization of events.

TEACHING SCHEDULE

THEORY [AEC-112]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Communication Process: The Magic of Effective Communication	Elements of Communication process such as Communicator, Message and Channel treatment of message, Audience and Audience response.	5
2	Building Self-esteem and Overcoming Fears	Points to build Self-esteem, Build social connections, Encourage yourself, Focus on solutions and Set realistic goals, Strategies to overcome fears, Practice, Visualise Success, Preparation, Know your audience, Seek feedback and Active listening.	5
3	Communication	Concept, Nature and Significance of Communication process	10
4		Meaning, Types and Models of communication	10
5		Verbal and Non-verbal communication, Linguistic and Non-linguistic communication	10
6		Barriers to communication and Reasons behind communication gap/ miscommunication	5
7	Basic Communication Skills	Listening, Speaking, Reading, Writing skills	5
8		Precis writing/ Abstracting/ summarizing- Styles of technical communication, Curriculum Vitae/resume writing	10
9		Innovative methods to enhance vocabulary, analogy questions	5
10	Structural and Functional Grammar	Sentence structure, modifiers, connecting words and verbal; Phrases and Clauses	5
11		Case: Subjective case, Possessive case, Objective case	5
12		Correct usage of nouns, Pronouns and Antecedents	5
13		Adjectives, Adverbs and Articles	5
14		Agreement of verbs with the subject: Tense, Mood, Voice	5
15		Writing effective sentences	5
16		Basic sentence faults	5
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [AEC-112]

Exercise No.	Exercise Topic
1	Listening and Note taking
2	Writing skills- Precis writing
3	Writing skills- Abstracting
4	Writing skills- Summarizing
5	Reading and Comprehension (written and oral) of general and technical articles
6	Micro-presentations
7	Impromptu presentations
8	Feedback on presentations
9	Stage manners- Grooming
10	Stage manners- Body language
11	Stage manners- Voice modulations, speed
12	Group discussions
13	Public speaking exercise
14	Vocabulary building exercises
15	Interview techniques
16	Organisation of events

Suggested Readings [AEC-112]:

1. **Allport, G W. 1937.** Personality: A Psychological Interpretation. Holt, New York.
2. **Brown, M. and Gyles, B. 1994.** How to Interview and be Interviewed. Sheldon Press, London.
3. **Dale, C. 1997.** The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. **Francis Peter, S.J. 2012**. Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. **Kumar, S. and Pushpa, L. 2011.** Communication Skills. Oxford University Press.
6. **Neuliep, J.W. 2003.** Intercultural Communication- A Contextual Approach. Houghton Mifflin Co Boston.
7. **Pease, Allan. 1998**. Body Language. Sudha Publications, Delhi.
8. **Raman, M. and Singh, P. 2000.** Business Communication. Oxford University Press.
9. **Ray, G L, 2008**. Extension, Communication and Management. Kalyani Publishers,Ludhiana
10. **Ray, G.L. and Mondal S. 2012.** Textbook on Rural Development Entrepreneurship and Communication Skills. Kalyani Publishers, Ludhiana.
11. **Seely, J. 2013.** Oxford Guide to Effective Writing and Speaking. Oxford University Press.
12. **Thomson, A.J. and Martinet, A.V. 1977.** A Practical English Grammar. Oxford University.

Semester	**:**	**I**	
Course No.	**:**	**MDC-111**	**Credit Hrs. : 3(2+1)**
Course Title	**:**	**Farming-based Livelihood Systems**	
Gradial Common Course across all UG degrees			

SYLLABUS

Objectives: (i) To make the students aware about farming-based livelihood systems in Agriculture

(ii) To disseminate the knowledge and skills that how farming-based systems can be a source of livelihood

THEORY

Status of Agriculture in India and different States, Income of farmers and Rural people in India, Livelihood-Definition, Concept and Livelihood pattern in urban and rural areas, Different indicators to study livelihood systems. Agricultural Livelihood Systems (ALS): Meaning, Approach, Approaches and Framework, Definition of farming systems and farming-based livelihood systems, Prevalent Farming systems in India contributing to livelihood. Types of Traditional and Modern farming systems. Components of farming system/ farming-based livelihood systems: Crops and Cropping systems, Livestock, (Dairy, Piggery, Goatry, Poultry, Duckry etc.), Horticultural crops, Agroforestry systems, Aquaculture, Duck/Poultry-cum-Fish, Dairy-cum-Fish, Piggery-cum-Fish etc.; Small, Medium and Large enterprises including value chains and secondary enterprises as livelihood components for farmers, Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country; Case studies on different livelihood enterprises associated with the farming. Risk and Success factors in farming-based livelihood systems, Schemes and Programs by Central and State Governments; Public and Private organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, Green economy, Climate change, Digitalization and Changing life style.

PRACTICAL

Survey of farming systems and Agriculture-based livelihood enterprises, Study of components of important farming-based livelihood models/systems in different agro-climatic zones, Study of production and profitability of crop based, livestock based, processing-based and integrated farming-based livelihood models, Field Visit of innovative farming system models. Visit of Agri-based enterprises and their functional aspects for integration of production, Processing and Distribution sectors and Study of agri-enterprises involved in industry and service sectors (Value Chain Models), Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in agri-sectors.

TEACHING SCHEDULE

THEORY [MDC-111]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1	Status of Agriculture in India	Historical background, Current status, Role of Agriculture in Indian Economy	4
2	Status of Agriculture in Different States	State-wise scenario, Major crops, Regional diversity	4
3	Income of Farmers and Rural People in India	Factors affecting income, Rural-urban income gap, Government initiatives	4
4	Livelihood: Definition, Concept, and livelihood Patterns in urban and rural areas	Livelihood- Definition and its Concept, Urban vs Rural livelihood patterns, Sources of income	4
5	Different Indicators to Study Livelihood Systems	Economic, Social and Environmental indicators, Measuring livelihood resilience	4
6	Agricultural Livelihood Systems (ALS): Meaning and Approaches	Definition, Significance of ALS, Integrated farming systems, Approaches	4
7	ALS Framework and Case studies	Framework for ALS, Case studies in India	4
8	Definition of Farming Systems and farming based Livelihood Systems	Definition and Role of farming systems in rural livelihoods, Examples of systems	4
9	Prevalent Farming Systems in India contributing to livelihood	Traditional vs. Modern farming systems, Regional differences	4
10	Types of Traditional and Modern Farming Systems	Types; Differences; Strengths, Limitations, Case studies	4
11	Components of farming system/farming-based livelihood systems - Crops and Cropping Systems	Components, Crop diversification, Cropping pattern, Mixed cropping, Importance for rural livelihoods	4
12	Livestock-based Farming Systems	Importance and Management of dairy, piggery, poultry, goatry, duckry, etc.	4
13	Horticultural Crops and Livelihoods	Role of fruits, vegetables and spices in rural income generation	4
14	Agroforestry Systems	Agroforestry- Definition, Combining trees and crops, Agroforestry models in India	2
15	Aquaculture as a Livelihood System	Importance of Aquaculture, Integrated systems (e.g. Duck/Poultry-cum-Fish, Dairy-cum-Fish, Piggery-cum-Fish etc.)	4
16	Challenges in Aquaculture-based Systems	Feasibility, Government support and Market access	2

Continued….

17	Small Enterprises in Farming	Role of small enterprises, Value addition, Local processing	2
18	Medium and Large Enterprises in Farming	Value chains, Secondary enterprises as livelihood components for farmers, Agri-processing.	2
19	Factors affecting Integration of various enterprises of farming for livelihood	Technology, Market access, Credit and infrastructure challenges etc.	4
20	Strategies for Enterprise Integration	Successful integration, Government policies, Examples.	2
21	Overview of Agro-Climatic Zones in India	Characteristics of different zones and their agricultural potential.	2
22	Feasibility of different Farming Systems for different Agro-Climatic Zones	Suitable farming systems for different zones, Climate adaptation.	2
23	Commercial Farming Based Livelihood Models by NABARD, ICAR and other organizations across the country	Role of NABARD, ICAR and other Organizations in promoting commercial models, Successful cases.	4
24	Case studies on different Livelihood Enterprises associated with farming	Analysis of successful enterprises, Dairy Cooperatives etc.	4
25	Risk Factors in Farming-based Livelihood Systems	Climate, Market fluctuations, Input costs; Mitigation strategies etc.	4
26	Success Factors in Farming-based Livelihood Systems	Innovation, Market access, Government support, Social capital etc.	2
27	Schemes and Programmes by the Central Government	Overview of schemes like, PM-KISAN, National Rural Livelihood Mission.	2
28	Schemes and programmes by State Governments	State-specific programs promoting rural livelihoods, Case examples.	2
29	Role of Private Sector in Livelihood Promotion	Public-Private Partnerships, Role of private agribusiness.	2
30	Public-Private Partnerships in Agriculture	Successful collaborations in rural development and farming systems	2
31	Farming-based Livelihoods in the 21st Century	Circular economy, Green economy, Climate change, Sustainability.	2
32	Impact of Digitalization and Changing Lifestyles	Technology in Agriculture, Future prospects for rural livelihoods.	2
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [MDC-111]

Exercise No.	Exercise Topic	Exercise Sub-topics/ Title
1	Survey of Farming Systems and Agriculture-based Livelihood Enterprises	Methods of data collection; Field survey techniques; Preparing reports on surveyed farms.
2	Study of Components of Farming-based Livelihood Models in Different Agro-Climatic Zones	Components: Crop, livestock, fishery, agroforestry; Identifying models suited to specific zones.
3	Study of Production and Profitability of Crop-based Models	Analysis of input-output relations; Identifying profitable crops
4	Study of Livestock-based Models	Livestock systems: Dairy, poultry, goat farming; Profitability and market access
5	Study of Processing-based Models	Value addition in agriculture; Studying small-scale food processing units
6	Study of Integrated Farming-based Models	Study of crop-livestock-aquaculture integration; Synergies and challenges
7	Field Visit to Innovative Farming System Models	Visit to farms using modern technologies; Documenting practices
8	Visit to Agri-based Enterprises	Enterprises involved in input supply or value addition
9	Study of Functional Aspects: Integration of Production, Processing and Distribution	Backward and forward linkages; Assessing supply chain models
10	Agri-Enterprises in Industry and Service Sectors (Value Chain Models)	Studying value chain enterprises; Evaluating sustainability models
11	Concept of Project Formulation on Farming-based Livelihood Systems	Identifying project objectives; Structuring budgets and timelines
12	Cost and Profit Analysis of Farming-based Livelihood Projects	Developing Cost-Benefit analysis; Identifying Break-Even points
13	Case Study of Start-ups in Agri-sectors	Analyzing real-world Start-ups; Identifying success factors
14	Group Project: Develop a Farming-based Livelihood Model	Formulating a working model; Feasibility and sustainability analysis
15	Preparation of Report on Farming Systems Survey and Livelihood Models	Compiling field data; Preparing reports with recommendations
16	Presentation and Evaluation of Practical Project Reports	Group presentations; Internal assessment of reports and participation

Suggested Readings (MDC-111):

1. **Ashley, C. and Carney, D. 1999**. *Sustainable Livelihoods: Lessons from Early Experience.* Department for International Development, London, UK.
    - **Relevance**: This book explores sustainable livelihood frameworks, which are key to understanding livelihood patterns and rural income systems.
2. **Agarwal, A. and Narain, S. 1989**. *Towards Green Villages: A Strategy for Environmentally Sound and Participatory Rural Development.* Centre for Science and Environment, New Delhi, India.
    - **Relevance**: Provides strategies for participatory rural development, focusing on environmental sustainability—a core concept in farming systems.
3. **Carloni, A. 2001**. *Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa.* FAO, Rome, Italy.
    - **Relevance**: Offers insights into global farming system challenges, with lessons that can be adapted for Indian contexts in agricultural development.
4. **Dixon, J., Gulliver, A. and Gibbon, D. 2001**. *Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World.* FAO & World Bank, Rome & Washington, DC.
    - **Relevance**: Focuses on farming systems' role in poverty alleviation and rural livelihood improvement.
5. **Evenson, R.E. 2000**. *Agricultural Productivity and Production in Developing Countries.* In *FAO, The State of Food and Agriculture.* FAO, Rome, Italy.
    - **Relevance**: Discusses agricultural productivity, a critical factor in sustainable farming and improved livelihoods.
6. **Bhatt *et al*. (ICAR Research Complex for Eastern Region)**. *Livelihood Improvement of Underprivileged Farming Community: Experiences from Bihar.* Patna, Bihar.
    - **Relevance**: Case studies on improving livelihoods in rural India, relevant to learning about region-specific agricultural interventions.
7. **Panwar *et al.*, 2020**. *Integrated Farming System Models for Agricultural Diversification, Enhanced Income, and Employment.* Indian Council of Agricultural Research, New Delhi.
    - **Relevance**: Provides models for agricultural diversification and income enhancement, which align with farming system topics.
8. **Reddy, S.R., 2016**. *Farming System and Sustainable Agriculture.* Kalyani Publishers, New Delhi.
    - **Relevance**: Covers sustainable agriculture principles and farming system models, essential for sustainable livelihood systems.
9. **Singh *et al.*, 2015**. *Region Specific Integrated Farming System Models.* ICAR-Indian Institute of Farming Systems Research, Modipuram.
    - **Relevance**: Discusses integrated farming models tailored to different agro-climatic regions of India, essential for practical learning.
10. **Walia, S.S., and Walia, U.S., 2020**. *Farming System and Sustainable Agriculture.* Scientific Publishers, Jodhpur, Rajasthan.
    - **Relevance:** Provides insights into sustainable agricultural practices and integrated farming systems with regional focus.

Semester	**:**	**I**	
Course No.	**:**	**MATH-111***	**Credit Hrs. : 2(2+0) Need-based; G/NG**
Course Title	**:**	**Basic Mathematics**	
***Gradial** Need-based Common Course for **B.Tech. (Biotechnology)**; ***Non-Gradial** Need-based Common Course for **B.Tech. (Agril. Engg.)** & **B.Tech. (Food Technology)**			

SYLLABUS

Objectives:

(i) To study the basic principles and functions in mathematics like limits and continuity,

(ii) To study differentiation and integration,

(iii) To study matrices and determinants.

THEORY

Functions:

Function and types of functions, Limit: Introduction, left-handed and right-handed limits, Algebra of limits, Standard limits. Continuity: Definition of continuity, continuity of algebraic functions. Continuity of trigonometric and exponential functions.

Differentiation:

Differentiation by the first principle, Rules of Differentiation: sum, difference, product and quotient formulae, differentiation using the chain rule, differentiation of functions in parametric and implicit form, logarithmic differentiation, geometrical interpretation of derivative. Successive differentiation, maxima and minima.

Integration:

Definition of indefinite integrals, Integrals of elementary functions (Formulae only), Theorems of integration (without proof), Integration by substitution, integration by partial fractions, integration by parts, Definition of definite Integral with examples, properties of definite integral (without proof).

Matrices and Determinants:

Definition of determinants, example up to Third order determinant, properties of determinant (statements only), Definition of matrix, types of matrices, Algebra of Matrix (addition, subtraction and multiplication), inverse of matrix, Solution of linear equations by Crammer's rule.

Teaching Schedule

THEORY

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1-5	**Functions:**	Definition of Function, Types of functions	15
		Some Basic Functions: Definition and Properties of: Constant Function, Identity Function, Power Function. Polynomial Function, Linear, quadratic and cubic function, Radical Function, Rational Function. Exponential, Logarithmic and Trigonometric Function	
	Limit:	Introduction, Definition of Limit, left-handed and right-handed limits, Algebra of limits	
		Standard limits: Method of Factorization, Rationalization, Limit of Trigonometric, Exponential Logarithmic and Functions. Limit of Infinity	
	Continuity:	Definition of continuity, Continuity of algebraic functions, Continuity of trigonometric and exponential functions.	
6 -15	**Differentiation:**	Definition, Differentiation by the first principle, Derivative of Some standard functions (Formulae only), Rules of Differentiation (Sum, Difference, Product and quotient without proof), Differentiation using the chain rule, Differentiation of functions in parametric and implicit form, Logarithmic Differentiation, Successive differentiation, Maxima and minima	30
16 -25	**Indefinite and Definite Integration**:	Definition of indefinite Integral, Integrals elementary functions (Formulae only) Theorems of integration (without proof) Methods of Integration: Integration by Substitution, Integration by parts, Integration by partial fractions Some special integrals formulae only. Definition of definite Integral with examples Properties of definite integral (Without proof)	30
26 -32	**Determinants and Matrices:**	Definition of determinants, Expansion up to third order determinant, Properties of determinant (statements only) Definition of matrix, Order of Matrix, Types of matrices, Algebra of Matrices, Inverse of matrix by elementary transformations, Solution of linear equations by Crammer's rule	25
		Total=	**100**

Suggested Readings:

1. NCERT, 2012, Mathematics of Class XII, NCERT, India.
2. A Text book of Mathematics XI and XII (Part I and II) Maharashtra State Board of Secondary and Higher Secondary Education, Pune.
3. Sharma RD, 2014, Mathematics of Class XII, Dhanpat Rai Publisher.

Semester	**:**	**I**		
Course No.	**:**	**BOT-111****	**Credit Hrs. : 2(2+0)**	**Need-based; G/NG**
Course Title	**:**	**Basic Botany**		
Need-based Common Course across 3 UG Degrees: **B.Tech. (Biotech.) - Gradial / B.Sc. (Hons.) A.B.M. - Gradial / B.Tech. (Food Tech.) - Non-Gradial				

SYLLABUS

Objectives: i. To study the basic taxonomy and classification of plants,
ii. To study the features of plant kingdom and morphology,
iii. To study the internal structure of plants.

THEORY

Plant Kingdom and features of each group. Plant taxonomy, Systems of classification. Morphology, Modifications and Functions of Root, Stem, Leaf, Flower and Inflorescence. Pollination and Fertilization. Fruit types. Structure of dicot and monocot seed, and seed germination. Cell structure. Chromosome, DNA and Genes. Cell and tissue types. Internal structure of root, stem and leaf. Characteristics and economic importance of Poaceae, Brassicaceae, Fabaceae, Malvaceae, Rutaceae, Rosaceae, Asteraceae and Solanaceae families.

TEACHING SCHEDULE

THEORY

Lecture No.	Topics	Sub-topics/ Key Points	Weightage (%)
1-3	Plant Kingdom and Features:	Classification of Plant Kingdom (Major plant groups: Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms.) Key distinguishing features/ characteristics of each group with examples. Plantae Kingdom.	8
4-5	Plant Taxonomy and Systems of Classification:	Binomial nomenclature and other systems of classification (in brief)	5
6-7	Plant Cell and Tissue Types:	Basic Structure of a Plant Cell and Tissue, Types of Plant Cells and Tissues; Plant Cell Functions.	8
8-9	Chromosome**:**	Definition and Overview, Chemical Composition; Chromosome Morphology, Types of Chromosomes**.**	8

Continued…

10-11	DNA:	Brief historical overview of DNA discovery, Watson-Crick model of DNA, Chemical composition, Components of a nucleotide, Structures of Purines and Pyrimidines.	8
12	Genes:	Definitions (Gene, Allele, Genotype, Phenotype, Exon, Intron, Codon) and Historical Overview; Structure: Basic layout of a gene- (Exon, Intron, etc.); Types of genes, Codons (Start/ Stop).	8
13-14	Pollination and Fertilization:	Definitions/Terminology, Types, Agents of pollination, Processes/Events, Significances, Barriers to Fertilization, Differences between their types.	10
15-16	Root and Stem:	Morphology, Modifications with examples and Functions	8
17-19	Leaf, Flower and Inflorescence**:**	Morphology, Modifications with examples and Functions	8
20	Fruits:	Types of fruits with examples	3
21-22	Structures of Monocot and Dicot Seeds:	Structure, Diagrams, Differences	5
23-24	Seed Germination:	Definitions, Types, Differences and Stages of seed germination	5
Plant taxonomy-Classification; Characteristics and Economic Importance; Members/ Examples of following Families viz.,			
25-26	Poaceae and Brassicaceae		4
27-28	Fabaceae and Malvaceae		4
29-30	Rutaceae and Rosaceae		4
31-32	Asteraceae and Solanaceae		4
		Total=	**100**

Suggested Readings [BOT-111]:

1. Bendre AM and Kumar A, 1999, Textbook of Practical Botany. Vol. 2, 7th Edn, Rastogi Publications.
2. Bendre AM and Pande PC, 2009, Introduction to Botany, Rastogi Publications.
3. Bhatia KN and Tyagi MP, 2020, Elementary Biology. A Truemen Publication.
4. David M Hillis, H Craig Heller, Sally D Hacker, David W Hall, David E Sadava, 2020. (eBook) Life: The Science of Biology, 12th Edn, Sunderland Publication.
5. Dutta AC, 1995, A Class-Book of Botany, 16th Edn, Oxford University Press.
6. NCERT, 2021. Biology of Class XI. NCERT, India.
7. Pande PC and Jain DK, 2022, A Textbook of Botany Angiosperm. S. Chand Publications.

Semester	**:**	**I**			
Course No.	**:**	**FT-111**	**Credits Hrs.**	**:**	**3(2+1)**
Course Title	**:**	**Fundamentals of Food Processing**			

SYLLABUS

Objectives: (i) To gain an understanding of the perishability of food and causes for food spoilage,
(ii) To have an idea of the basic methods of preservation of food and
(iii) To impart knowledge about non-thermal processing of food.

THEORY

Food: Definition and Functions, Classification of foods, sources, types and perishability of foods; Causes and types of food spoilage; Scope and benefit of food preservation. Food processing: Introduction, levels and techniques; Methods of food preservation; Preservation by salt and sugar: Principle, method and effect on food quality. Preservation by heat treatment: Principle, process and equipment for blanching, canning, pasteurization, sterilization. Preservation by use of low temperature: Principle, methods, equipments. Preservation by drying, dehydration and concentration: Principle, methods, equipments. Preservation by irradiation: Principle, methods, equipments. Preservation by chemicals-antioxidants, mould inhibitors, antibodies, acidulants, Hurdle technology etc. Preservation by fermentation: Principles, methods, equipments. 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, Cold Plasma technology, etc. Quality tests and shelf-life of preserved foods.

PRACTICAL

Demonstration of various perishable food items and degree of spoilage; Blanching of selected food items; Preservation of food by heat treatment- Pasteurization; Preservation of food by high concentration of sugar: Jam; Preservation of food by using salt: Pickle; Preservation of food by using acidulants i.e. pickling by acid, vinegar or acetic acid; Preservation of food by using chemical preservatives; Preservation of bread, cake using mold inhibitors; Drying of fruit slices pineapple slices, apple slices in cabinet drier; Drying of green leafy vegetables; Drying of mango/ other pulp by foam-mat drying; Drying of semisolid foods using roller dryers; Drying of foods using freeze drying process; Demonstration of preserving foods under cold vs. freezing process; Processing of foods using fermentation technique, i.e. preparation of sauerkraut; Study on effect of high pressure on microbe; Study on effect of pulse electric field on food.

TEACHING SCHEDULE

THEORY [FT-111]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1-2	Food	i) Definition and Functions, ii) Classification of foods, sources, iii) Types and perishability of foods iv) Causes and types of food spoilage v) Scope and benefit of food preservation.	10
3-5	Food processing	i) Introduction, levels and techniques ii) Methods of food preservation iii) Preservation by salt and sugar: Principle, method and effect on food quality.	10
6-8	Preservation by heat treatment	Principle, process and equipment for blanching, canning, pasteurization, sterilization.	10
9-12	Preservation by use of low temperature	Principle, methods, equipment.	14
13-14	Preservation by drying, dehydration and concentration	Principle, methods, equipment.	8
15-16	Preservation by irradiation	Principle, methods, equipment.	8
17-19	Preservation by chemicals.	Antioxidants, mould inhibitors, antibodies, acidulants, Hurdle technology etc.	5
20-21	Preservation by fermentation	Principles, methods, equipment.	5
22-25	Quality tests and shelf-life of preserved foods.	Physico-chemical, Sensory attributes shelf-life determination by using two methods i.e. Real time shelf life and Accelerated shelf life.	10
26-32	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, Cold Plasma technology, etc.	20
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [FT-111]

Exercise No.	Exercise Title
1	Demonstration of various perishable food items and degree of spoilage
2	Blanching of selected food items
3	Preservation of food by heat treatment- Pasteurization
4	Preservation of food by high concentration of sugar: Jam
5	Preservation of food by using salt: Pickle
6	Preservation of food by using acidulants i.e. Pickling by acid, vinegar or acetic acid
7	Preservation of food by using chemical preservatives
8	Preservation of bread and cake using mold inhibitors
9	Drying of fruit slices- pineapple slices and apple slices in cabinet drier
10	Drying of green leafy vegetables
11	Drying of mango/ other pulp by foam-mat drying
12	Drying of semisolid foods using roller dryers
13	Drying of foods using freeze drying process
14	Demonstration of preserving foods under cold vs. freezing process
15	Processing of foods using fermentation technique, i.e. preparation of sauerkraut
16	Study on effect of high pressure on microbe; Study on effect of pulse electric field on food.

Suggested Readings [FT-111]:

1. Brennan, J.G. 2006. Food Processing Handbook. Wiley-VCH Verlag GmbH and Co KGaA, Weinheim, Germany.
2. Desrosier N.W. and Desrosier, J.N. 1977. The Technology of Food Preservation. 4th edn. AVI Publishing Co., Connecticut, USA. Fellows, P. 2000.
3. Food Processing Technology: Principles and Practice. 2nd edn. CRC Press, Boca Raton, FL, USA.
4. Karel, M. and Lund, D.B. 2003. Physical Principles of Food Preservation. 2nd edn. Marcel Dekker, Inc., NY, USA.
5. Lal, G., Siddappa, G.S. and Tandon, G.L. 1959. Preservation of Fruits and Vegetables. ICAR, New Delhi.
6. Potter, N. N. and Hotchkiss, J.H. 1995. Food Science. 5th edn. Chapman and Hall, NY, USA. Rahman, M.S. 2007. Handbook of Food Preservation. 2nd edn. CRC Press, Boca Raton, FL, USA. Stavros Y. 2008.
7. Solving Problems in Food Engineering. Springer Science + Business Media, NY, USA. Tewari, G. and Juneja, V.K. 2007.
8. Advances in Thermal and Non-Thermal Food Preservation. Blackwell Publishing, Ames, Iowa, USA.
9. Zeuthen, P. and Bùgh-Sùrensen, L. 2003. Food Preservation Techniques. CRC Press LLC, Boca Raton, FL, USA.

Semester	**:**	**I**			
Course No.	**:**	**FQA-111**	**Credit Hrs.**	**:**	**3(2+1)**
Course Title	**:**	**Food Chemistry-I**			

SYLLABUS

Objectives:

(i) To learn the chemical aspects of food and bio-materials and its importance in food processing,
(ii) To gain an understanding of various water and macro-molecules and
(iii) To have an idea of about the effect of processing on these biomolecules.

THEORY

Water; Moisture in foods, Role and type of water in foods, Functional properties of water, Water activity and Sorption isotherm, Molecular mobility and Foods stability; Dispersed systems of foods: Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations); Rheology of diphase systems. Carbohydrates; Monosaccharaides, Disaccharides and Polysaccharides, Modification of carbohydrates, Dietary fibers and Carbohydrates digestibility; Enzymatic and Chemical reactions of carbohydrates. Proteins in foods: Proteins-Classification, Structure and Properties; Proteins and Nutrition, Functional properties of proteins; Processing induced, Physical, Chemical and Nutritional changes in protein; Chemical and Enzymatic modification of protein. Lipids in foods: Classification, structure and properties of lipids; Role and use of lipids/fat, Crystallization and Consistency, Chemical aspects of lipids, Lipolysis, Auto-oxidation, Thermal decomposition, Chemistry of frying technology of fat and oil; Oil processing: Refining, Hydrogenations, Inter esterification, Use of oils and Fats in food formulation. Enzymatic and Chemical reactions of fats; Rancidity and its types, Detection techniques, Chemical aspects of lipids, Antioxidants.

PRACTICAL

Determination of moisture content of foods using different methods; Studies of sorption isotherms of different foods; Swelling and Solubility characteristics of starches; Rheological properties of food systems; Determination of crude proteins by Micro-Kjeldhal method; Determination of essential amino acids i.e. lysine, tryptophan, methionine, etc.; Isolation of egg and milk protein; Preparation of protein isolate and Concentrate of proteins; Determination of Acid value, Saponification value and Iodine number of fat/oil; Assay of amylases, Papain and Lipases.

TEACHING SCHEDULE

THEORY [FQA-111]

Lecture No.	Topic	Subtopics/ Key Points	Weightage (%)
1-6	Water	1. Moisture in foods, Role and Types of water in foods, Functional properties of water. 2. Water activity and sorption isotherm, Molecular mobility and Foods stability. 3. Dispersed systems of foods. 4. Physicochemical aspects of food dispersion system (Sol, gel, foam, emulations). 5. Rheology of diphase systems.	20
7-13	Carbohydrates	1. Monosaccharides, Disaccharide and Polysaccharides, 2. Modification of carbohydrates, 3. Dietary fibers and Carbohydrates digestibility. 4. Enzymatic and Chemical reactions of carbohydrates.	20
14-19	Proteins in foods	1. Classification, Structure and Properties, 2. Proteins and Nutrition, 3. Functional properties of proteins, 4. Processing induced Physical, Chemical and Nutritional changes in protein, 5. Chemical and Enzymatic modification of protein.	20
20-26	Lipids in foods	1. Classification, Structure and Properties of lipids. 2. Role and Use of lipids/fat. 3. Crystallization and Consistency. 4. Chemical aspects of lipids, Lipolysis, Auto-oxidation, Thermal decomposition. 5. Chemistry of frying technology of fat and oil. 6. Oil processing: Refining, hydrogenation's, Inter esterification, Use of oils and fats in food formulation.	25
27-32	Enzymes	1. Enzymatic and Chemical reactions of fats, 2. Rancidity and its types, 3. Detection techniques, 4. Chemical aspects of Lipids, Antioxidants.	15
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [FQA-111]

Exercise No.	Exercise Title
1	Study of laboratory equipments/ apparatus
2	Determination of moisture content of foods using different methods
3	Qualitative test for carbohydrates
4	Qualitative test for amino acids
5	Qualitative test for proteins: (Salting out test, acid precipitation of protein test)
6	Qualitative test for lipids/fats
7	Studies of sorption isotherm of different foods
8	Swelling and solubility characteristics of starches
9	Determination of total sugar and reducing sugar in food
10	Determination of crude proteins by Micro-Kjeldhal method
11	Preparation of protein isolate and concentrate of proteins
12	Test for detection of different oils (Baudouin test, Halphens test)
13	Test for detection of different oils (Hexabromide test)
14	Determination of Acid value of fat/oil
15	Determination of Saponification value and Iodine number of fat/oil
16	Experiments with food enzymes

Suggested Readings [FQA-111] :

1. **Brady, J.W. 2013.** Introductory Food Chemistry. Comstock Publishing Associates, Cornell University Press, Ithaca, USA.
2. **Belitz, H.D., Grosch, W. and Schieberle, P. 2009.** Food Chemistry, 4th edn. Springer-Verlag Berlin Heidelberg.
3. **Fennema, O.R. 1996.** Food Chemistry, 3rd Edn. Marcel Dekker, Inc., New York, USA.
4. **Meyer, L.H. 1974.** Food Chemistry. The AVI Publishing Co Inc., Connecticut, MA, USA.

Semester	**:**	**I**	
Course No.	**:**	**FQA-112**	**Credit Hrs. : 3(2+1)**
Course Title	**:**	**General Microbiology**	

SYLLABUS

Objectives:

(i) To identify the micro-organisms, their structure and growth characteristics and

(ii) To acquaint with techniques for cultivation and preservation and control.

THEORY

Scope and History of Microbiology: (Notable contributions of Leeuwenhoek, Pasteur, Koch, etc.). Place of Microorganisms in Living World; Groups of Microorganisms; Applied area of Microbiology. Classification and Identification of microorganisms; Major Characteristics of Microorganisms, Methods of classification of bacteria. Microscopy: Introduction to microscope; Component of microscope; Types of microscope and Microscopic techniques. Microbial Ultrastructure and Functions: Morphological features; Structures external to cell wall, Cell wall; Structures internal to cell wall. Cultivation and Preservation of microorganisms: Nutritional requirements; Types of media. Physical condition required for the growth; Enumeration methods for microorganisms. Bacterial Metabolism and Growth: Reproduction of bacteria; Growth of bacteria: Growth curve, Continuous culture, Synchronous culture; Methods of isolation of pure cultures; Maintenance and Preservation of pure cultures; Culture collections. Control of microorganisms: Physical and Chemical agents. Bacterial Genetics. Structure and Functions of DNA and RNA; Overview of replication and regulation.

PRACTICAL

Practical Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (Monochrome staining, Gram staining, Negative staining, Capsule-staining, Flagella staining and Endospore staining); Pure culture techniques (Streak plate/Pour plate/Spread plate); Identification procedures (Morphology and Cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, Direct plate count, generation time; Factors influencing growth: pH, Temperature, Growth curves for bacteria.

TEACHING SCHEDULE

THEORY [FQA-112]

Lecture No.	Topic	Sub-topics/Key Points	Weightage (%)
1-2	Scope and History of Microbiology	Notable Contributions of Leeuwenhoek, Pasteur, Koch, Edward Jenner, Ignaz Semmelweis, Louis Pasteur Joseph Lister, Paul Ehrlich, Alexander Fleming, etc. in Microbiology. Scope and economic importance of microorganisms, Applied area of Microbiology: Industrial Microbiology, Aquatic and Marine Microbiology, Public health Microbiology, Immunology, Food and Dairy Microbiology.	5
3-4	Place of Microorganisms in Living World;	Overview of the major groups of microorganisms, Role of Microorganisms in Ecosystem and Human Health, Ecosystem: Nutrient cycling, Organic matter decay, Pollution remediation, Climate change Human Health: Digestion, Immune system, Detoxification, Protection, Reproductive health.	5
5-10	Classification and Identification of Microorganisms	Microbial classification, Nomenclature and Identification; Taxonomic groups; General-, Methods of classifying bacteria; Major Characteristics of microorganisms: Cell types (Prokaryotic and Eukaryotic) and Presence of nuclear membrane; Methods of classification of bacteria: Gram stain, Shape, Cell wall composition, Respiration and Nutrition; Other methods for classifying microbes include: Differential staining, Biochemical testing, DNA fingerprinting or DNA base composition, Polymerase Chain Reaction and DNA Chips.	10
11-14	Microscopy	Microscopy and Microscopes: Principles, Simple and Compound microscopes, Phase. i) Introduction to microscope; ii) Types of microscopes: Optical microscopes, Electron microscopes, Scanning probe microscopes, Atomic force microscopes (AFMs), iii) Components of microscope: iv)Microscopic Techniques: Fluorescent microscopy, Electron microscopy (SEM and TEM), Applications, Smears and Staining	10

Continued…

15-17	Microbial Ultrastructure and Functions:	General structure of Prokaryotic and Eukaryotic Cells, Cell wall, Plasma membrane, Protoplasm, Endoplasmic reticulum, Lysosome, Golgi apparatus, Centriole, Cilia, Flagellum, Storage bodies, Ribosomes, Chloroplasts, Mitochondria and Nucleus. Morphology and Fine Structure of Bacteria, Size, Shape, Arrangement and Bacterial structures: Flagella, Pili, Capsule, Sheaths and Stalks.	10
18-21	Cultivation and Preservation of Microorganisms:	Cultivation of Bacteria, Nutritional requirements; Nutritional classification of Bacteria; Phototrophs, Chemotrophs, Autotrophs and Heterotrophs; Obligate parasites. Bacteriological media, Types of media and Physical conditions required for growth, Reproduction of Bacteria- Binary fission, budding. Maintenance and preservation of pure cultures; Methods of isolation of pure cultures: Streak plate, Pour plate and Spin plate methods; Growing the culture, Preserving in glycerol, Cryopreservation, Lyophilization, Maintenance media; Culture collections: Preservation, Distribution, Catalogues.	13
22-25	Bacterial Metabolism and Growth	i) Reproduction of Bacteria: Binary fission, Other Asexual reproduction methods, Genetic recombination, Factors affecting reproduction, Reproduction in different species, Sexual reproduction. ii) Growth of bacteria: Growth curve and phases; Continuous culture: Chemostat, Turbidostat, Perfusion Synchronous culture: Cell synchronization, Growth Kinetics, Quantitative measurement of bacterial growth; Recombination machinery, Meiotic recombination.	12
26-30	Control of Microorganisms	i) Physical agents: Temperature, Radiation, Other energies; ii) Chemical agents: Disinfectants, Antiseptics, Antibiotics, Chemotherapeutic antimicrobial chemicals.	15
31	Bacterial Genetics	Bacterial recombination; Mutation; Gene transfer, Transduction, Homologous recombination, Plasmids, Conjugation, DNA replication.	10
32	Structure and Functions of DNA and RNA	Overview of Replication and Regulation, Structure, Function, Sugar, Bases, Nucleotides, Nitrogen bases and Types of RNA.	10
		Total=	**100**

TEACHING SCHEDULE

PRACTICAL [FQA-112]

Exercise No.	Exercise Title
1	Experiment on Microscopy
2	Experiment on Micrometry
3	Cleaning and sterilization of glassware and acquainting with equipment used in Microbiology
4	Preparation of nutrient agar media and techniques of inoculation
5	Staining methods: Study on Monochrome staining
6	Staining methods: Study on Gram staining, negative staining
7	Staining methods: Study on Capsule-staining
8	Staining methods: Study on Flagella staining
9	Staining methods: Study on Endospore staining
10	Pure culture techniques (Streak plate)
11	Pure culture techniques (Pour plate)
12	Pure culture techniques (Spread plate)
13	Identification procedures (Morphology and Cultural characteristics)
14	Growth characteristics of bacteria: Determination of microbial numbers, direct plate count.
15	Generation time; Factors influencing growth: Effect of pH on growth curves for bacteria.
16	Generation time; Factors influencing growth: Effect of temperature on growth curves for bacteria.

Suggested Readings [FQA-112]:

1. **Pelczar Jr., M.J., Chan, E.C.S. and Krieg, N.R. 1998.** Microbiology. 5thedn. Tata McGraw-Hill Education, New Delhi.
2. **Tortora, G.J., Funke, B.R. and Case, C.L. 2014.** Microbiology: An Introduction. 12thedn. Prentice-Hall, NY, USA.
3. **Willey, J.M., Sherwood, L.M. and Woolverton, C.J. 2013.** Prescott's Microbiology. 9th edn. McGraw-Hill Higher Education, NY, USA.

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Semester	**:**	**I**		
Course No.	**:**	**FE-111**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Post Harvest Engineering**		

SYLLABUS

Objectives: (i) To understand the basic post-harvest operations,

(ii) To gain an understanding of various engineering properties and

(iii) To differentiate between different types of material handling systems.

THEORY

Overview of Post-Harvest Technology. Concept and Science, Introduction to different Agricultural crops, their Cropping pattern, Production, Harvesting and Post-harvest losses, Reasons for losses, Importance of loss reduction, Post-Harvest Handling operations. Water Activity; Water binding and its effect on Enzymatic and Non-enzymatic reactions and Food texture, Control of water activity and Moisture. Engineering Properties of Food Materials; Physical, Thermal, Aerodynamic, Optical, Mechanical, Rheological and Electromagnetic properties and their measurement. 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), Cleaning efficiency, Care and Maintenance; Peeling. Sorting, Grading, Methods of grading; Grading- Size grading, Colour grading, Specific gravity grading; Screening, Equipment for grading of fruits and vegetables, Grading efficiency, Care and Maintenance. Magnetic separator, Destoners, Electrostatic separators, Pneumatic separator. Decorticating and Shelling; Principles of working, Design and Constructional details, Operating parameters, Maintenance, etc. of various decorticators/dehullers/shellers, Description of groundnut decorticators, maize shellers, etc. Milling, Polishing, Grinding, Milling equipment, De-huskers, Polishers (abrasion, friction, water jet), Flour milling machines, Pulse milling machines, Grinders, Cutting machines, Oil expellers, Machine efficiency and Power requirement. Materials handling; Introduction to different conveying equipment used for handling of grains; Scope and Importance of material handling devices. Study of different Material Handling systems; Classification, Principles of operation, Conveyor system selection/design; Belt conveyor: Principle, Characteristics, Design, Relationship between belt speed and width, Capacity, Inclined belt conveyors, Idler spacing, Belt tension, Drive tension, Belt tripper; Chain conveyor: Principle of operation, Advantages, Disadvantages, Capacity and Speed, Conveying chain; Screw conveyor: Principle of operation, Capacity, power, Troughs, Loading and Discharge, Inclined and Vertical screw conveyors; Bucket elevator: Principle, Classification, Operation, Advantages, Disadvantages, Capacity, Speed, Bucket pickup, Bucket discharge, Relationship between belt speed, Pickup and Bucket discharge, Buckets types, Power requirement; Pneumatic conveying system: Types, Air/Product separators; Gravity conveyor design considerations, Capacity and Power requirement.

PRACTICAL

Study of cleaners for grains; Study of washers for fruits and vegetables; Study of graders for grains; Study of graders for fruits and vegetables; Study of decorticators; Study of a maize/ sunflower sheller; Study of crop dryers; Study of a RF/MW/tray dryer; Study of hot air dryer and modelling drying kinetics; Study of vacuum dryer and modelling drying kinetics; Study of working principle of spray dryer and spray drying process; Study of drum dryer and liquid food dehydration using drum drying; Study of fluidized bed dryer and drying process; Study of freeze dryer and freeze drying process; Study of different materials handling equipment.

TEACHING SCHEDULE

THEORY [FE-111]

Lecture No.	Topic	Sub-topics/ Key Points	Weightage (%)
1-2	Overview of Post-Harvest Technology	Definition and Overview of Post-Harvest Technology/ Engineering	5
3-5	Concept and Science	Introduction to different agricultural crops, Cropping Pattern, Production, Post harvesting and Post-harvest losses, Reasons for losses, Importance of loss reduction, Post-harvest handling operations.	10
6-8	Water Activity	Water binding, Effects on enzymatic and Non-enzymatic reactions and Food texture, Control of water activity and moisture.	10
9-14	Engineering Properties of Food Materials	Physical, Thermal, Aerodynamic, Optical, Mechanical, Rheological and Electromagnetic properties and their measurement.	10
15-16	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); Cleaning efficiency; Care and Maintenance; Peeling.	10
17-20	Sorting, Grading and Methods of grading	Size grading, Colour grading, Specific gravity grading; Screening, equipment for grading of fruits and vegetables, Grading efficiency, Care and maintenance, Magnetic Seperator, Destoners, Electrostatic separators, Pneumatic separator	15

Continued…

21-23	Decorticating and Shelling	Working Principle, Design and Constructional details, Operating parameters, Maintenance of various decorticators/ dehullers/ shellers, groundnut decorticators, Maize shellers etc.	10
24-26	Materials Handling	Different conveying equipments used for handling of grains; Scope and importance of material handling devices	10
27-32	Different Material Handling Systems	Classification, Principles of operation, Conveyor system selection/design; Belt conveyor: Principle, Characteristics, Design, Relationship between belt speed and width, capacity, inclined belt conveyors, idler spacing, belt tension, drive tension, belt tripper; Chain conveyor: Principle of operation, Advantages, Disadvantages, Capacity and Speed, Conveying chain; Screw conveyor: Principle of operation, Capacity, Power, Troughs, Loading and Discharge, Inclined and Vertical screw conveyors; Bucket elevator: Principle, Classification, Operation, Advantages, Disadvantages, Capacity, Speed, Bucket pickup, Bucket discharge, Relationship between belt speed, pickup and bucket discharge; Buckets types, power requirement; Pneumatic conveying system: types, air/product separators; Gravity conveyor: design considerations, capacity and power requirement.	20
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [FE-111]

Exercise No.	Exercise Title
1	Study of cleaners for grains
2	Study of washers for fruits and vegetables
3	Study of graders for grains
4	Study of graders for fruits and vegetables
5	Study of decorticators
6	Study of a maize/ sunflower sheller
7	Study of crop dryers
8	Study of a RF/MW/Tray dryer
9	Study of hot air dryer and modelling drying kinetics
10	Study of vacuum dryer and modelling drying kinetics
11	Study of working principle of spray dryer and spray drying process
12	Study of drum dryer and liquid food dehydration using drum drying
13	Study of fluidized bed dryer and drying process
14	Study of freeze dryer and freeze-drying process
15	Study of different materials handling equipment (Belt conveyors and Screw Conveyors)
16	Study of different materials handling equipment (Pneumatic conveyors)

Suggested Readings [FE-111]:

1. **Boumans, G. 1985.** Grain Handling and Storage. Elsevier Science Publishers, Amsterdam, The Netherlands.
2. **Brennan, J.G. 2006.** Food Processing Handbook. Wiley-VCH Verlag GmbH and Co. KGaA, Weinheim, Germany.
3. **Chakraverty, A. 2008.** Post Harvest Technology of Cereals, Pulses and Oilseeds, 3rd edn. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. **Chakraverty, A. and Singh, R.P. 2014.** Post Harvest Technology and Food Process Engineering. CRC Press, Boca Raton, FL, USA.

List/ Bouquet of Skill Enhancement Courses (SECs)

Discipline/ Department	Sr. No.	Course No.	Course Title	Credits (Hrs.)
Food Technology	**1**	FT/SEC	Introduction to Drying Technology and Dryers	2(0+2)
	2	FT/SEC	Introduction to Processing of Extruded Foods	2(0+2)
	3	FT/SEC	Introduction to Milling (Rice, Dal, Spices, etc.)	2(0+2)
Food Quality Assurance	**1**	FQA/SEC	Introduction to Food Safety and Sanitation	2(0+2)
	2	FQA/SEC	Introduction to Good Laboratory Practices	2(0+2)
	3	FQA/SEC	Basic Food Analysis Laboratory Techniques	2(0+2)
Food Engineering	**1**	FE/SEC	Introduction to Electrical and Control Systems in Food Industry	2(0+2)
	2	FE/SEC	Introduction to Mechanical Systems in Food Industry	2(0+2)
	3	FE/SEC	Introduction to AutoCAD	2(0+2)
Food Plant Operations	**1**	FPO/SEC	Maintenance of Food Processing Equipment	2(0+2)
	2	FPO/SEC	Introduction to Bottling and Canning Line	2(0+2)
	3	FPO/SEC	Introduction to Manufacturing of Bakery Products	2(0+2)

Note : Skill Enhancement Courses can be added/offered as per the facilities and resources available at the respective universities/colleges based on the relevance to the region and the UG degree subject.

In case of unavailability of said detailed course-wise syllabus of above SEC courses, the same can be primarily developed and followed at College/ University level in the academic year, 2024-25; However, the same will be obtained from the respective UG Degree Coordinator/ Discipline Coordinators and can be followed w.e.f. AY, 2025-26.

[Above list is an indicative list/bouquet of SEC courses and subject to modification as applicable therein]

Skill Enhancement Courses (SECs): Detailed Syllabi

Food Technology

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Drying Technology and Dryers**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1	Introduction to drying process and its mechanism
2	Understanding of different methods for moisture estimation
3	Determination of moisture content with oven method
4	Determination of drying characteristics and study of kinetics
5	Prediction of moisture sorption isotherms
6	Determination of equilibrium moisture content of grain
7	Introduction to different dryings theories and its importance
8	Introduction to different methods of drying (Contact, Convective and Radiation).
9	Principle and Operational mechanism involved in Cabinet and Tunnel Drying
10	Principle and Operational mechanism involved in Spray Drying
11	Principle and Operational mechanism involved in Roller/ Drum Drying
12	Principle and Operational mechanism involved in fluidized bed drying
13	Principle and Operational mechanism involved in foam-mat drying
14	Principle and Operational mechanism involved in microwave drying
15	Principle and Operational mechanism involved in vacuum oven drying
16	Principle and Operational mechanism involved in solar drying
17	Principle and Operational mechanism involved in refractance window drying of foods

18	Study of pretreatment methods for drying and dehydration
19	Study of operational principle and working of freeze dryer
20	Study of Rehydration/ Reconstitution properties of dehydrated foods
21	Drying of fruit slices in cabinet drier
22	Drying of green leafy vegetables
23	Drying of mango/ other pulp by foam-mat drying
24	Drying of foods using roller dryer and Spray dryer
25	Drying of foods using freeze drying process
26	Preparation of Mango Leather
27	Preparation of Osmo-Dehydrated Food Products (Candied Fruits, Glazed Fruits)
28	Preparation of dehydrated raisins
29	Study of packaging, labelling and FSSAI Regulations of Dehydrated products
30	Industrial Visit(s) to different dehydration Units
31	Case study on fruits and vegetable drying

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Processing of Extruded Foods**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1	Introduction and market survey of extruded products
2	Introduction of food extruders components and their functions
3	Principle and operational mechanism involved in cold and hot extruder (Single and Twin-Screw Extruder)
4	Preparation of spaghetti pasta
5	Preparation of penne pasta
6	Preparation of noodles
7	Preparation of vermicelli
8	Preparation of instant noodles
9	Quality evaluation of pasta products
10	Demonstration of extrusion products (extruded snacks/ breakfast cereal/ texturized vegetable protein)
11	Preparation of traditional extruded products (sev/ chakli)
12	Evaluation of physical properties of expanded snacks
13	Evaluation of water and milk hydration properties of breakfast cereal
14	Evaluation of functional properties of expanded snacks
15	Evaluation of functional properties of texturized vegetable protein
16	Preparation of plant-based meat analogue by using extruder
17	Preparation of cereal, pulses based ready-to-eat snack food by extrusion cooking
18	Preparation of extruded confectionary product
19	Effect of feed moisture content on extrudate food product characteristic
20	Studies on development of weaning food by extrusion technology
21	Texture profile analysis of extruded product

22	Preparation of dietary fiber rich extruded product
23	Quality evaluation of commercially available extruded food products
24	Packaging of Extruded products
25	Quality evaluation of different extruded products
26	Determination of techno-economic feasibility of prepared extruded product
27	Sensory evaluation of prepared extruded products
28	Labelling and FSSAI Regulations of different extruded products
29-30	Visit to Commercial Extrusion Unit

Semester	**:**	**I**		
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Introduction to Milling (Rice, Dal, Spices, etc.)**		

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1	Introduction and market survey of milled rice, dal and spices
2	Determination of Physical Properties of rice grain, dal and spices
3	To study the defects in grains and milled rice, dal and spices by physical observation
4	Determination of moisture content in different milled product
5	Studies on traditional methods of milling of dal and rice grains
6	Cleaning of rice, dal and spices for milling
7	Studies on different dehusking and deshelling equipments involved in the milling of paddy grains
8	Principles and Operational mechanism of rice mills
9	Determination of Head Rice Yield (HRY), Milled Rice Yield (MRY) and % Brokens
10	Determination of polishing quality of paddy
11	Studies on different by-products of paddy milling
12	Studies on different methods and pretreatments involved in pulse milling
13	Studies on Dry milling and Wet milling of pulses for production of dal
14	Principles and Operational mechanism of Dal Mills
15	Cleaning and inspection for effective grading and sieving of grains based on size and grade
16	Demonstration of the procedure of cleaning of unprocessed whole spices
17	Principles and Operational mechanism of Spice Mills
18	Manufacture of Dalia from cereals and legumes

19	Production process of rice from paddy
20	Study on Mini Dal Mill
21	Studies on utilization of by-products from dal milling industry
22	Preparation of turmeric powder
23	Preparation of curry powder
24	Recipe formulation and preparation of different spice mix powders (Turmeric, Chilli, Onion, Ginger etc.)
25	Sieve analysis of milled products for particle size distribution
26	Milling yield calculation for different grains
27	Packaging and storage techniques for milled products
28	Techno-economic feasibility of prepared spice powder and milled dal
29	Case study on spice powder processing industries
30	To study milling quality of rice, dal and spices
31	Study of packaging, labelling and FSSAI Regulations of Dehydrated products
32	Visit to Commercial Rice mill, Dal mill and Spice industry.

Food Quality Assurance

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Food Safety and Sanitation**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Understanding Food Safety and Sanitation: Concept, Terms and Importance
3-4	Developing the process flow for the food establishment including all the inputs, outputs and interim loops
5-6	Data collection for identification of biological, chemical and physical hazards
7-8	Hazard Analysis using FMEA Technique for Risk Assessment
8	Demonstration of Correct method of washing hands
9	Assessment of personal hygiene
10-11	Identifying the Key Focus Areas for GHP and GMP
12-13	Identifying Gaps in its Implementation; Closure Plans for Identified Gaps
14-15	Importance of temperature control and Demonstrating proper cooking, cooling and reheating temperatures using thermometers
16-17	Introduction to HACCP
18-19	Development of OPRP (Operational Pre-requisite Programme) and Development of HACCP Plan (Critical Limits including Rationale for Limits)
20-21	Monitoring Procedure, Correction and Corrective Measures
22-23	Introduction to Cleaning agents and Techniques for Sanitizing surfaces
24-25	Hands-on Demonstration of using Chemical Sanitizers correctly
26-27	To recognize signs of pest infestations and methods of control
28-29	Demonstration of segregation of waste
30-31	To study proper disposal methods for different types of waste
31-32	Practice identifying common food allergens and labelling

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Good Laboratory Practice**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Introduction and Importance of Good Laboratory Practices
3-4	Practical session on identifying hazards and using appropriate Personal Protective Equipment
5-6	Hands-on practice with common lab equipment (e.g., microscopes, pipettes, balances, centrifuges etc.)
7-8	Equipment calibration techniques and How to properly maintain instruments
9-10	Techniques for cleaning, drying and sterilizing lab glassware to prevent contamination
11-12	Autoclave operation for Sterilization, Calibration of balances, pH meters and Spectrophotometers
13-14	Sample collection techniques for biological, chemical, or environmental samples
15-16	Correct labelling and storage procedures to maintain integrity
17-18	Proper segregation and disposal of hazardous and non-hazardous lab waste
19-20	Understanding chemical compatibility and safe disposal practices
21-22	Performing basic quality control tests like titration, pH measurement and UV-Vis Spectrophotometry to assess the purity and quality of samples
23-25	Aseptic techniques for handling microbial cultures, preparing agar plates and transferring cultures
26-28	Detecting, recording and reporting errors or deviations in experimental work
29-30	Writing and following SOPs for basic lab techniques like, solution preparation or instrument usage

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Basic Food Analysis Laboratory Techniques**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Sampling plan; Sample collection and preparation for analysis
3-4	Sensory evaluation techniques of food products
5-6	Quality evaluation of food products for color and taste of marketed products
7-8	Determination of moisture content in food samples
9-10	Water analysis
11-12	Determination of ash content in food samples
12-13	Determination of crude fat in food samples
14-15	Determination of crude protein in food samples by Kjeldahl method
15-16	Determination of crude fibre in food samples
17	Qualitative tests for sugars
18-19	Qualitative tests for proteins, Colorimetric estimation of protein concentration
20-21	Estimation of total and reducing sugars
22-23	Measuring the pH of various food samples like fruits, dairy, and beverages
24-25	Determining the acidity in food samples by titrating with a base
26-27	Determination of Total Soluble Solids and Vitamin C in food samples
28	Determination of Salt Content in food samples
29-30	Estimation of chlorophyll and carotenoids in food samples
31	Estimation of Macro and Micro Minerals
32	Visit to NABL-Accredited Food Laboratory

Food Engineering

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Electrical and Control Systems in Food Industry**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Build simple electrical circuits using resistors, capacitors and inductors
3	Measurement of voltage, current and resistance using a multimeter
4-5	Explore different types of sensors used in food processing
6-7	Performing calibration exercises with EC/ pH meter. Study of different types of motors (AC, DC, Stepper) and their applications
8-9	Developing a motor control circuit for a conveyor system
10-11	Programming simple control sequences using PLC software
12	Creating a basic ladder logic diagram for a conveyor belt system
13	Simulating PID control for a temperature control system
14-15	Designing a simple HMI using software tools (like Factory Talk or Win CC)
16-17	Integrating the HMI with PLC for monitoring and control
18-19	Setting-up a small SCADA system for monitoring a food processing operation
20-21	Understanding data logging and visualization techniques
22	Learning about industrial communication protocols (Modbus, Ethernet/IP)
23	Creating a simple network setup to connect PLCs and HMIs
25	Building and analyze a control loop for a food processing scenario (e.g. Pasteurization)
26	Understanding feedback mechanisms and their importance in control systems
27	To diagnose and troubleshoot faulty electrical circuits
28	To develop systematic approaches to identify common issues
29	To measure and analyze energy consumption in a small-scale food processing set-up
30	To explore energy-saving practices and technologies in the industry
31	Safety Protocols in Electrical Systems
32	Visit of food industry for practical exposure of electrical and control system

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Introduction to Mechanical Systems in Food Industry**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Introduction to mechanical system and its application in food industry
3-4	To identify and understand the function of basic mechanical components (gears, belts, pulleys, bearings) used in food machinery
5-6	To study different materials used in food machinery and their properties
7-8	To practice the assembly and disassembly of simple food processing machines (e.g., mixers, blenders)
9-10	To measure and analyze vibration in food processing equipment
11-12	To learn how to identify issues such as misalignment or imbalance
13-14	To perform routine maintenance tasks on mechanical systems (lubrication, belt tensioning)
15-16	To conduct troubleshooting exercises to identify and fix common mechanical failures
17	Study of principles, construction and working of Cleaning equipments
18	Study of principles, construction and working of Sorting/grading equipments
19	Study of principles, construction and working of Washing equipments
20	Study of principles, construction and working of Handling equipments
21	Study of principles, construction and working of Food packaging machines
22-23	To conduct tests to evaluate corrosion resistance and suitability for food contact
24-25	To explore the use of robotic systems for tasks such as packing or palletizing
26-27	To implement quality control measures in a mechanical process (e.g., measuring dimensions of food products)
28-29	To create basic mechanical drawings using CAD software
30-31	Project work to enlist various mechanical parts and its functionality in different food processing industries
32	Visit of Food Industry to identify mechanical systems in food processing

Semester	**:**	**I**		
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Introduction to AutoCAD**		

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Introduction to AutoCAD and its application in the food processing industry
3-4	Familiarization with the AutoCAD interface: toolbars, menus, and command line
4-5	Practice using drawing tools to create geometric shapes
6-7	Experiment with drawing precision using grid and snap features
8	Learning to modify objects using commands such as move, copy, rotate, scale and mirror
9	To perform exercises on editing shapes and lines in an existing drawing
10	To create and manage layers in a drawing
11	To assign different colours and line types to layers for better organization
12	To add linear, radial and angular dimensions to drawings
13-14	To practice dimensioning techniques and understand best practices for clarity
15	To insert text and annotations into a drawing
16	To explore styles and formatting options for clarity and presentation
17-18	To draw a complete 2D engineering drawing of an equipment
19	Introduction to 3D modelling: create basic 3D shapes (cubes, cylinders)
20-21	To practice using 3D viewing tools and rendering techniques
22-23	Setting-up a layout for printing: scaling, title blocks and viewports
24-25	Understanding the file types and compatibility issues (DWG, DXF) to save the AutoCAD files
26	To attach and manage external references in a drawing
27-28	To develop a detailed plan (floor plan, mechanical part) incorporating multiple elements
29-30	To create isometric drawings to represent three-dimensional objects in two dimensions
31-32	To practice isometric dimensioning and labeling

Food Plant Operations

Semester	**:**	**I**			
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**:**	**2(0+2)**
Course Title	**:**	**Maintenance of Food Processing Equipment**			

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Hands-on identification of various types of food processing equipment
3-4	Creation of customized preventive maintenance checklists for different equipment
5-6	Simulated execution of a preventive maintenance routine
7	Understanding the types of lubricants used in food processing
8	Practicing proper lubrication techniques on machinery
9-10	Learning about different cleaning agents and their appropriate use
11-12	Conducting cleaning protocols on equipment in compliance with food safety standards
13-14	Practical exercises in electrical troubleshooting, including circuit testing and voltage measurement
15-16	Dismantling and reassembling parts of common food processing equipment
17-18	Simulated troubleshooting of common equipment malfunctions
19-20	Simulating the documentation of maintenance activities and creating maintenance logs
21	Study of maintenance of cleaning equipment
22-23	Study of care and maintenance of Sorting/Grading equipment
24-25	Study of care and maintenance of Milling equipment
26-27	Study of and care and maintenance of Drying equipment
28-29	Study of care and maintenance of Material Handling equipment
30-31	Study of care and maintenance of Packaging equipment
32	Study of care and maintenance of Storage units

Semester	**:**	**I**		
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Introduction to Bottling and Canning Line**		

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic/ Title
1-2	Introduction to bottling and canning process
3	Study of sorting and grading equipments
4	Study of washing equipments
5	Study of peeling methods and equipments
6	Study of cutting equipments
7	To perform the blanching of fruits and vegetables
8	To check the adequacy of blanching process
9-10	Study of different types of bottles and cans, including materials and sizes
11	Study of different filling techniques (gravity, pressure, vacuum)
12	Practical session on filling bottles/cans accurately
13	Cutout analysis of cans
14	Hands-on practice on in-bottle sterilization
15	Hands-on practice with various sealing methods (screw caps, corks, can lids)
16	Testing seal integrity using various methods
17	Practical session on labeling machinery operation
18	Coding and printing best practices for product information
19	Conduct quality checks on filled and sealed products
20	Discuss common quality issues and troubleshooting techniques
21	Study of domestic carbonator and carbonation process
22	Learn proper cleaning and sanitation protocols for equipment
23-24	Hands-on cleaning sessions for different parts of the line
25	Basic maintenance tasks for key equipments
26	Troubleshooting common problems in bottling and canning lines
27	Workshop on regulations affecting bottling and canning
28	Product Handling and Storage
29	Practical session on proper storage techniques
30-31	Study of packaging, labelling and FSSAI Regulations of beverages and canned products
32	Visit to Beverage and Canning Industry

Semester	**:**	**I**		
Course No.	**:**	**SEC-xxx**	**Credit Hrs.**	**: 2(0+2)**
Course Title	**:**	**Introduction to Manufacturing of Bakery Products**		

TEACHING SCHEDULE

PRACTICAL

Exercise No.	Exercise Topic
1-2	Introduction and market survey of bakery products
3-4	Study of different methods of preparation of bakery product (Bread, Biscuit, Cake and Cookies etc.)
5-6	Determination of Gluten Content in wheat flour
7-8	Determination of Sedimentation value of wheat flour
9-10	Determination of Pelshenke value of wheat flour
11-12	Determination of water and oil absorption of flour
13-14	Determination of emulsion capacity and stability of flour
15-16	Determination of foaming capacity and stability of flour
17-18	Determination of alkaline water retention capacity of flour
19-20	Preparation and quality evaluation of composite formulation of wheat-based cookies
21-22	Preparation and quality evaluation of millet-based cookie formulations
23-24	Preparation and quality evaluation of crackers
25-26	Preparation and quality evaluation of unleavened flat breads
27-28	Preparation and quality evaluation of leavened breads (White bread, Brown Bread)
29	Preparation and quality evaluation of cake/muffin
30	Preparation and quality evaluation of baked cereal bar
31	Study of packaging, labelling and FSSAI Regulations of bakery products
32	Visit a Commercial Bakery Unit