BIRLA INSTITUTE OF TECHNOLOGY

CHOICE BASED CREDIT SYSTEM (CBCS) CURRICULUM

(Effective from Academic Session: Monsoon 2018)

NAME OF THE PROGRAMME

IMSc. (FOOD TECHNOLOGY)

NAME OF THE DEPARTMENT

CHEMICAL ENGINEERING

Institute Vision

To become a Globally Recognised Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research, and technological service to the National needs.

Institute Mission

- To educate students at Undergraduate, Postgraduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education, and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision:

To be a center of excellence for the provision of effective teaching/learning, skill development and research in the areas of chemical engineering and allied areas through the application of chemical engineering principles.

Department Mission

1) To educate and prepare graduate engineers with critical thinking skills in the areas of chemical engineering & polymer science and engineering, who will be the leaders in industry, academia and administrative services both at national and international levels.

2) To inculcate a fundamental knowledge base in undergraduate students which enable them to carry out post-graduate study, do innovative interdisciplinary doctoral research and to be engaged in long-life learning.

3) To train students in addressing the challenges in chemical, petrochemical, polymer and allied industries by developing sustainable and eco-friendly technologies.

Graduate Attributes

1. Disciplinary knowledge and skills: Capable of demonstrating comprehensive knowledge and understanding of major concepts of food processing and its sub fields

2. Communication skills: Ability to express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.

3. Critical Thinking: Capability to apply analytical thought to a body of knowledge, analyse and evaluate evidence.

4. Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one‟s learning to real life situations.

5. Research related skills: Ability to recognize cause and effect relationship, define problems, formulate hypotheses and draw conclusions. Ability to plan, execute, report the results of an experiment or an investigation.

6. Cooperation/ Team work: Ability to work effectively with diverse teams, act together as a group or a team and work efficiently as a member of team.

7. Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative/ qualitative data

8. Information/ Digital literacy: Capability to use ICT in a variety of learning situations.

9. Self directed learning: Ability to work independently, identify appropriate resources required for a project and manage a project

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

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

12. **Project Management and Finance:** Demonstrate knowledge and understanding of 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.

Programme Educational Objectives (PEOs)

PEO 1: To develop knowledge and understanding about systems in the production, processing and consumption of food and an appreciation of their impact on society.

PEO 2: To impart knowledge about the nature of food and human nutrition and an appreciation of the importance of food to health.

PEO 3: To build up skills in researching, analyzing and communicating issues related to food preservation, processing, storage and packaging.

PEO 4: To enhance skills in experimenting with and development of food products and equipment by applying theoretical concepts.

PEO 5: To develop skills in designing, implementing and evaluating solutions to food industry situations.

(A) Programme Outcomes (POs)

IMSc Graduates will be able to:

1. Disciplinary knowledge and skills: Capable of demonstrating comprehensive knowledge and understanding of major concepts of food processing and its sub fields

2. Communication skills: Ability to express thoughts and ideas effectively in writing and orally and communicate with others using appropriate media.

3. Critical Thinking: Capability to apply analytical thought to a body of knowledge, analyse and evaluate evidence.

4. Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one‟s learning to real life situations.

5. Research related skills: Ability to recognize cause and effect relationship, define problems, formulate hypotheses and draw conclusions. Ability to plan, execute, report the results of an experiment or an investigation.

6. Cooperation/ Team work: Ability to work effectively with diverse teams, act together as a group or a team and work efficiently as a member of team.

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

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

12. **Project Management and Finance:** Demonstrate knowledge and understanding of 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.

(B) Programme Specific Outcomes (PSOs)

PSO 1: Students will develop ability to evaluate the impact and apply good manufacturing practices in food industry on the individual, society & environment with success skills in interpretation, communication, critical thinking, interaction, information acquisition, organization, professionalism, leadership, auto-didactics and life-long-learning.

PSO 2: Students will develop ability to explain the role of nutrients in human health and develop, prepare and present food products using modern processing, preservation and packaging techniques, and lean to analyze them in quality perspective.

PSO 3: Students will be prepared to be professionals with the skills and know-how that will enable them to explain and understand manufacturing processes and technologies used in the production of food products, examine the nature and extent of the food industry, justify processes of food product manufacturing and equipment design in terms of market, technological and environmental considerations.

PROGRAMME COURSE STRUCTURE (ALL SEMESTERS)

BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI **NEW COURSE STRUCTURE - To be effective from academic session 2018- 19** **Based on CBCS & OBE model** **Recommended scheme of study For B.Sc and Integrated M.Sc in Food Technology**								
Semester/ Session of Study (Recommended)	**LEVEL**	**Category of course**	**Course Code**	**Courses**	**Mode of delivery & credits** *L-Lecture; T-Tutorial;P-Practicals*			**Total Credits** *C-Credits*
					L (*Periods/week*)	**T *(Periods/week)***	**P *(Periods/week)***	**C**
	THEORY							
FIRST Monsoon	FIRST	BS	PH 113	Physics	3	1	0	4
			MA 103	Mathematics I	3	1	0	4
		GE	CS 101	Programming for problem solving	3	1	0	4
		PC	BE 203	Microbiology	3	0	0	3
		LABORATORY						
		BS	PH114	Physics Lab	0	0	3	1.5
			CS 102	Programming for problem solving Lab	0	0	3	1.5
		GE	PE 101	Workshop Practises	0	0	3	1.5
		MC	MC 101/102/103 /104	NCC/ NSS/PT & Games/ Creative Arts				1
								20.5
	THEORY							
SECOND Spring	FIRST	BS	CE101	Environmental Science	2	0	0	2
			CH 101	Chemistry	3	1	0	4
			MA 107	Mathematics II	3	1	0	4
	SECOND	HSS	MT 123	Business communication	2	0	2	3
	FIRST	GE	EC 101	Basics of Electronics & Communication Engineering	3	1	0	4
		LABORATORY						
	SECOND	PC	BE 201	Microbiology Lab	0	0	3	1.5
	FIRST	BS	CH 102	Chemistry Lab	0	0	3	1.5
		GE	EC 102	Electronics and Communication Lab	0	0	3	1.5
		MC	MC 105/106/107 /108	NCC/ NSS/PT & Games/ Creative Arts				1
								22.5
	THEORY							

THIRD Monsoon	SECOND	PC	FT201	Food Chemistry	4	0	0	4
			FT 202	Introduction to Food Engineering	3	0	0	3
			FT 203	Food Microbiology	4	0	0	4
			FT204	Basics of Food Processing & Preservation	4	0	0	4
			FT 205	Introduction to Agricultural Practices	4	0	0	4
		LABORATORY						
		PC	FT 206	Food Chemistry Lab	0	0	4	2
			FT 207	Food Preservation Lab	0	0	4	2
			FT208	Food Microbiology Lab	0	0	4	2
		MC	MC 201/202/203 /204	NCC/ NSS/PT & Games/Creative Art				1
								26
	THEORY							
FOURTH Spring	SECOND	PC	FT 209	Food Analysis	4	0	0	4
			FT210	Food Biochemistry and Human nutrition	4	0	0	4
			FT211	Fruits and Vegetable Processing Technology	4	0	0	4
			FT212	Fluid Mechanics and Mechanical Operations	3	1	0	4
		OE		Open Elective - I	3	0	0	3
		LABORATORY						
	SECOND	PC	FT213	Fruits and Vegetable Processing Lab	0	0	4	2
			FT214	Food Analysis Lab-I	0	0	4	2
		GE	ME102	Engineering Graphics	0	0	4	2
		MC	MC 205/206/207 /208	PT & Games/NCC/NSS/CA				1
								26
	THEORY							
FIFTH Monsoon	THIRD	PC	FT301	Cereal Pulses & Oilseeds Technology	4	0	0	4
			FT302	Heat Transfer in Food Processing	3	0	0	3
			FT303	Meat, Fish and Poultry Product Technology	4	0	0	4
		PE		Programme Elective-I	3	0	0	3
		OE		Open Elective- II	3	0	0	3
		LABORATORY						
	THIRD	PC	FT304	Cereal Technology Lab	0	0	4	2
			FT305	Food Product Development Lab	0	0	4	2
			FT306	Food Analysis Lab-II	0	0	4	2

		SPT	FT307	Industrial Training 4 weeks				2
								25
	THEORY							
SIXTH Spring	THIRD	PC	FT 308	Dairy Technology	4	0	0	4
			FT309	Mass Transfer in Food Processing	3	0	0	3
			FT310	Thermodynamics and Refrigeration	3	0	0	3
		PE		Programme Elective II	3	0	0	3
		HSS	FT311	Food Business Management	3	0	0	3
		LABORATORY						
		PC	FT312	Dairy Technology Lab.	0	0	4	2
		PE	FT313	Food Engineering Lab	0	0	4	2
		RP	FT300	Dissertation	0	0	10	5
								25
			TOTAL CREDIT FOR B.Sc. Honours (Food Technology)					**145**
I.M.Sc. Food Technology (Semester VII to X semester) /M.Sc. Food Technology (Semester I to IV Semester)								
	THEORY							
M.Sc. (FIRST) / I.M.Sc. (SEVENTH) Monsoon	FOURTH	PC	FT 401	Bakery and Confectionary Technology	3	1	0	4
			FT 402	Food Laws Safety and Quality	3	1	0	4
			FT 403	Advanced Food Chemistry and Microbiology	3	1	0	4
			FT 404	Fats and Oils Technology	3	1	0	4
	SECOND	BS For Lateral Entry	FT 201	Food Chemistry	3	0	0	-
			FT 203	Food Microbiology	3	0	0	-
		OE		Open Elective I	3	0	0	3
		HSS	MT 204	Constitution of India	2	0	0	Non Credit
		LABORATORY						
	FOURTH	PC	FT407	Advanced Food Chemistry and Microbiology Lab	0	0	6	3
			FT409	Advanced Food Processing Lab 1	0	0	4	2
								24
	THEORY							
M.Sc. (SECOND) / I.M.Sc. (EIGTH) Spring	FOURTH	PC	FT410	Novel Techniques in Food Processing and Packaging	3	1	0	4
			FT411	Food Product Development and Consumer Science	3	1	0	4
		PE		Programme Elective III	3	0	0	3
				Programme Elective IV	3	0	0	3
		OE		Open Elective II	3	0	0	3

	FOURTH	FC for Lateral Entry	FT209	Food analysis	3	0	0	Non Credit
		LABORATORY						
		PC	FT414	Advanced Food Analysis Lab I	0	0	6	3
			FT415	Advanced Food Processing Lab II	0	0	4	2
								22
	THEORY							
M.Sc. (THIRD) / I.M.Sc. (NINTH) Monsoon	FIFTH	PC	FT501	Flavour Chemistry and Technology	3	1	0	4
			FT502	Food Processing Plant Engineering & Layout	3	1	0	4
			FT503	Applied Statistics for Food Technology	3	1	0	4
		PE		Programme Elective V	3	0	0	3
				Programme Elective VI	3	0	0	3
		LABORATORY						
	FIFTH	PC	FT504	Advanced Food Analysis Lab II	0	0	4	2
			FT505	Advanced Food Product Development Lab	0	0	4	2
								22
M.Sc. (FOURTH) / I.M.Sc. (TENTH) Spring	FIFTH	RP	FT500	Dissertation	3	0	0	12
								12
		TOTAL CREDIT [I-IV SEMESTER]						**80**
	I.M.Sc. Food Technology (Semester VII to X semester) /M.Sc. Food Technology (Semester I to IV Semester)							
	Grand Total for I.M.Sc.(Semester I to Semester X)=(145+80)=225							

DEPARTMENT OF CHEMICAL ENGINEERINGPROGRAMME ELECTIVES (PE)OFFERED FOR LEVEL 1-4 I.M.SC FOOD TECHNOLOGY

PE / LEVEL		**Code no.**	**Name of the PE courses**	**Prerequisites courses with code**	**L**	**T**	**P**	**C**
3	PE 1	FT320	Food Additives & Ingredients	FT 201	3	0	0	3
3		FT321	Flavour Chemistry & Technology	FT 201	3	0	0	3

3		FT 322	Food Toxicology	FT 201	3	0	0	3
3	PE 2	FT330	Food Packaging Technology	FT202	3	0	0	3
3		FT331	Food Industry Waste Management	FT 201, FT 202	3	0	0	3
3		FT332	Technology of Plantation Crops and spices	FT 201	3	0	0	3
4	PE 3	FT420	Principles of Food Processing and Preservation	FT 201, FT 203	3	0	0	3
4		FT421	Automation in Food Processing Industry	FT 201, FT 203	3	0	0	3
4		FT422	Enzymes in Food Processing	FT 201, FT 203	3	0	0	3
4	PE 4	FT423	Food Processing Technology	FT 201, FT 203	3	0	0	3
4		FT424	Post Harvest Engineering	FT 201, FT 203	3	0	0	3
4		FT425	Food Supply Chain Management	FT 201, FT 203	3	0	0	3
5	PE 5	FT 511	Computer Application in Food Industry	FT 201, FT 202	3	0	0	3
5		FT 512	Food Biotechnology	FT 201, FT 202	3	0	0	3
5		FT 513	Grain Storage Technology	FT 201, FT 202	3	0	0	3
6	PE 6	FT 514	Nutraceutical & Functional Foods	FT 201, FT 202	3	0	0	3
6		FT 515	Food Processing Equipment Design	FT 201, FT 202	3	0	0	3
6		FT 516	Agricultural and Rural Economics	FT 201, FT 202	3	0	0	3
*FT420 and FT 423 are only for Lateral Entry								
**** PROGRAMME ELECTIVES TO BE OPTED ONLY BY THE FOOD TECHNOLOGY STUDENTS**								

DEPARTMENT OF CHEMICAL ENGINEERING
PROGRAMME ELECTIVES (PE)
OFFERED FOR LEVEL 1-4 I.M.SC FOOD TECHNOLOGY

PE / LEVEL		Code no.	Name of the PE courses	Prerequisites courses with code	L	T	P	C
3	PE 1	FT320	Food Additives & Ingredients	FT 201	3	0	0	3
3		FT321	Flavour Chemistry & Technology	FT 201	3	0	0	3
3		FT 322	Food Toxicology	FT 201	3	0	0	3
3		FT330	Food Packaging Technology	FT202	3	0	0	3
3	PE 2	FT331	Food Industry Waste Management	FT 201, FT 202	3	0	0	3
3		FT332	Technology of Plantation Crops and spices	FT 201	3	0	0	3
4	PE 3	FT420	Principles of Food Processing and Preservation	FT 201, FT 203	3	0	0	3
4		FT421	Automation in Food Processing Industry	FT 201, FT 203	3	0	0	3
4		FT422	Enzymes in Food Processing	FT 201, FT 203	3	0	0	3
4	PE 4	FT423	Food Processing Technology	FT 201, FT 203	3	0	0	3
4		FT424	Post Harvesst Engineering	FT 201, FT 203	3	0	0	3
4		FT425	Food Supply Chain Management	FT 201, FT 203	3	0	0	3
5	PE 5	FT 511	Computor Application in Food Industry	FT 201, FT 202	3	0	0	3
5		FT 512	Food Biotechnology	FT 201, FT 202	3	0	0	3
5		FT 513	Grain Storage Technology	FT 201, FT 202	3	0	0	3
6	PE 6	FT 514	Nutraceuticals & Functional Foods	FT 201, FT 202	3	0	0	3
6		FT 515	Food Processing Equipment Design	FT 201, FT 202	3	0	0	3
6		FT 516	Agricultural and Rural Economics	FT 201, FT 202	3	0	0	3

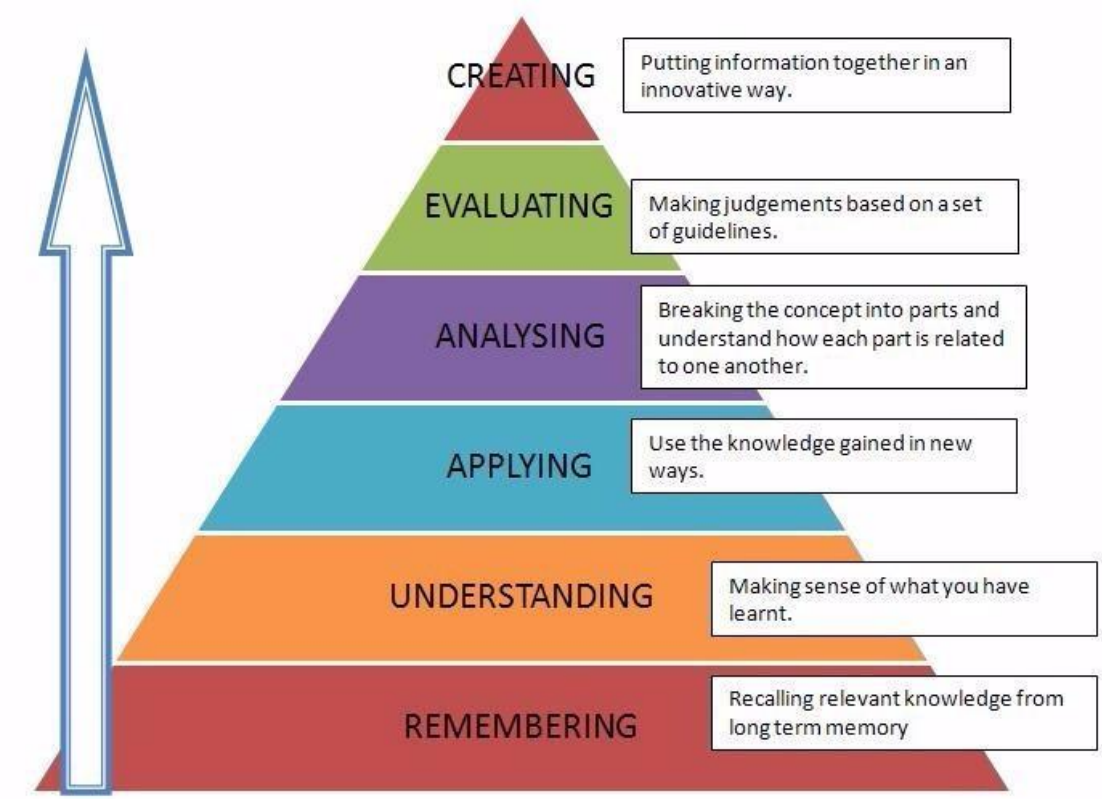
*FT420 and FT 423 are only for Lateral Entry

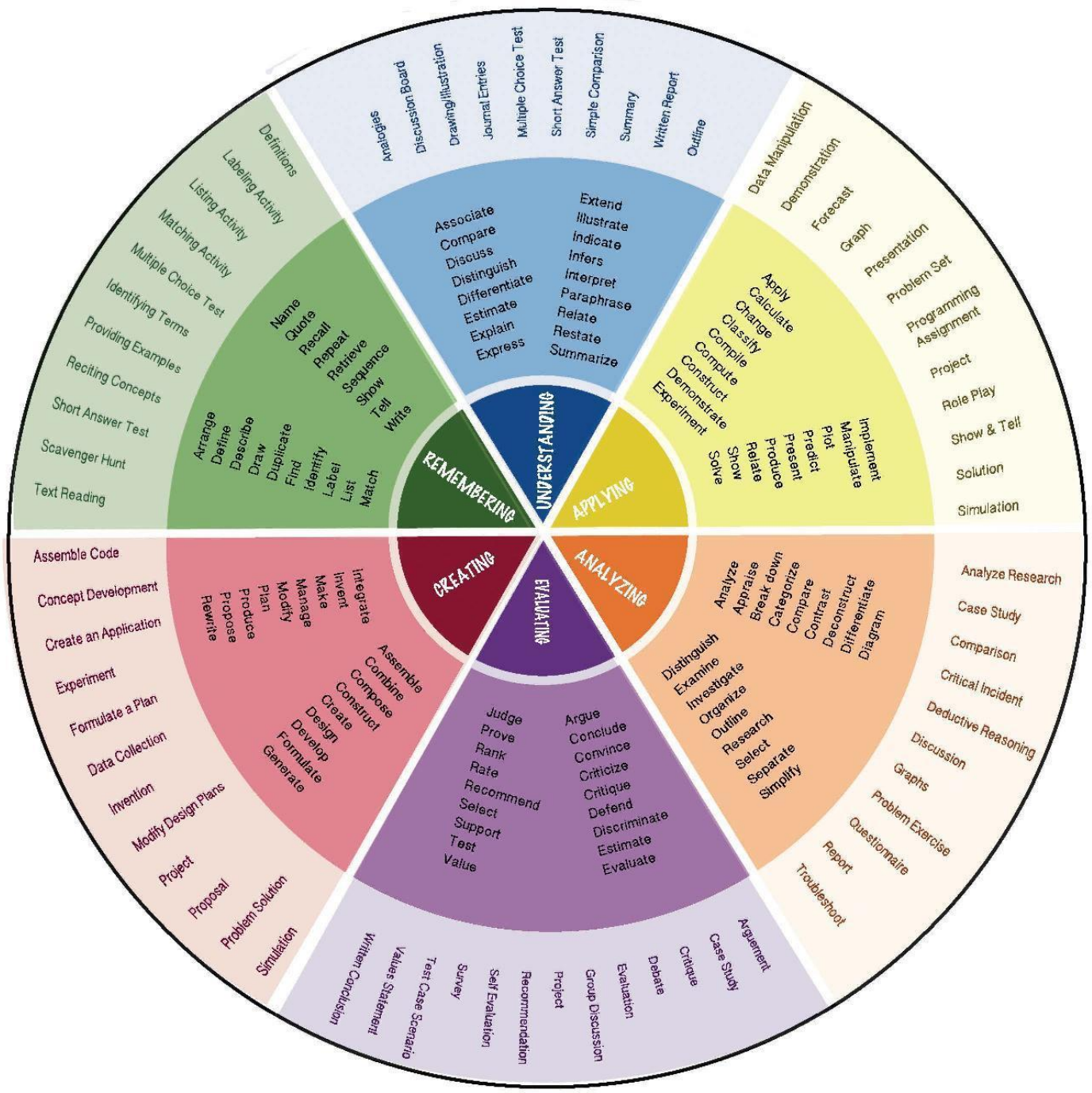
**** PROGRAMME ELECTIVES TO BE OPTED ONLY BY THE FOOD TECHNOLOGY STUDENTS**

BLOOM'S TAXONOMY FOR CURRICULUM DESIGN AND ASSESSMENT:

Preamble

The design of curriculum and assessment is based on Bloom's Taxonomy. A comprehensive guideline for using Bloom's Taxonomy is given below for reference.




REMEMBERING
UNDERSTANDING
APPLYING
ANALYZING
EVALUATING
CREATING
Definitions
Labeling Activity
Listing Activity
Matching Activity
Multiple Choice Test
Identifying Terms
Providing Examples
Reciting Concepts
Short Answer Test
Scavenger Hunt
Text Reading
Name
Quote
Recall
Repeat
Retrieve
Sequence
Show
Tell
Write
Arrange
Define
Describe
Draw
Duplicate
Find
Identify
Label
List
Match
Analogies
Discussion Board
Drawing/Illustration
Journal Entries
Multiple Choice Test
Short Answer Test
Simple Comparison
Summary
Written Report
Outline
Associate
Compare
Discuss
Distinguish
Differentiate
Estimate
Explain
Express
Extend
Illustrate
Indicate
Infers
Interpret
Paraphrase
Relate
Restate
Summarize
Data Manipulation
Demonstration
Forecast
Graph
Presentation
Problem Set
Programming Assignment
Project
Role Play
Show & Tell
Solution
Simulation
Apply
Calculate
Change
Classify
Compile
Compute
Construct
Demonstrate
Experiment
Implement
Manipulate
Pilot
Predict
Present
Produce
Relate
Show
Solve
Analyze Research
Case Study
Comparison
Critical Incident
Deductive Reasoning
Discussion
Graphs
Problem Exercise
Questionnaire
Report
Troubleshoot
Analyze
Appraise
Break down
Categorize
Compare
Contrast
Deconstruct
Differentiate
Diagram
Distinguish
Examine
Investigate
Organize
Outline
Research
Select
Separate
Simplify
Argument
Case Study
Critique
Debate
Evaluation
Group Discussion
Project
Recommendation
Self Evaluation
Survey
Test Case Scenario
Values Statement
Written Conclusion
Judge
Prove
Rank
Rate
Recommend
Select
Support
Test
Value
Argue
Conclude
Convince
Criticize
Critique
Defend
Discriminate
Estimate
Evaluate
Assemble Code
Concept Development
Create an Application
Experiment
Formulate a Plan
Data Collection
Invention
Modify Design Plans
Project
Proposal
Problem Solution
Simulation
Integrate
Invent
Make
Manage
Modify
Plan
Produce
Propose
Rewrite
Assemble
Combine
Compose
Construct
Create
Design
Develop
Formulate
Generate

SYLLABUS (ALL SEMESTERS)

COURSE INFORMATION SHEET

Course code:	**PH 113**
Course title:	**Physics**
Pre-requisite(s):	**Intermediate Physics &Mathematics**
Co- requisite(s):	
Credits:	**L: 03 T: 01 P: 00**
Class schedule per week:	**04**
Class:	**B. Tech**
Semester / Level:	**I/01**
Branch:	**All**
Name of Teacher:	

Course Objectives

This course enables the students:

1.	To explain principles of physical optics
2.	To construct Maxwell's equations from basic principles and use it to solve electromagnetic plane wave equations
3.	To distinguish between Newtonian Mechanics and special theory of relativity and develop the relationship of length contraction, time dilation and Einstein energy mass relation and to apply the concepts of special theory of relativity in various field of physics and engineering.
4.	To illustrate the phenomena of old quantum theory and derive Heisenberg uncertainty principle and Schrödinger's equations
5.	To understand basic lasing action, study various types of lasers and to have basic idea of fiber optics.

Course Outcomes

After the completion of this course, students will be:

CO 1	To interpret the intensity variation of light due to Polarization, interference and diffraction.
CO 2	To formulate and solve the engineering problems on electromagnetism.
CO 3	To explain special theory of relativity and apply its concepts in various fields of physics and engineering.
CO 4	To explain fundamentals of quantum mechanics and apply it to problems on bound states.
CO 5	To analyze working principle of lasers and to summarize its applications.

PH 113: Physics
SYLLABUS

Module1: (9L)

Physical Optics: Polarization, Malus' Law, Brewster's Law, Double Refraction, Interference in thin films (Parallel films), Interference in wedge-shaped layers, Newton's rings, Fraunhofer diffraction by single slit, Double slit.

Module2: (9L)

Electromagnetic Theory: Curl, Gradient, Divergence, Gauss theorem, Stokes theorem, Gauss's law, Applications, Concept of electric potential, Relationship between E and V, Polarization of dielectrics, dielectric constant, Boundary conditions for E & D, Gauss's law in magnetostatics, Ampere's circuital law, Boundary conditions for B & H, Equation of continuity of charge, Displacement current, Maxwell's equations.

Module3: (9L)

Special Theory of Relativity: Introduction, Inertial frame of reference, Galilean transformations, Postulates, Lorentz transformations and its conclusions, Length contraction, time dilation, velocity addition, Mass change, Einstein's mass energy relation.

Module4: (9L)

Quantum Mechanics: Planck's theory of black-body radiation, Compton effect, Wave particle duality, De Broglie waves, Davisson and Germer's experiment, Uncertainty principle, physical interpretation of wave function, Schrodinger equation in one dimension, free particle, particle in an infinite square well.

Module5: (9L)

Lasers: Spontaneous and stimulated emission, Einstein's A and B coefficients, Population-inversion, Light amplification, Basic laser action, Ruby and He-Ne lasers, Properties and applications of laser radiation, Elementary ideas of fiber optics and application of fiber optic cables.

Text books:

1. Optics, by A. Ghatak, 4th Edition, Tata Mcgraw Hill, 2009 (T1)
2. Elements of Electromagnetics by Mathew N.O. Sadiku,, Oxford University Press, 2001 (T2)
3. Concept of Modern Physicsby Arthur Beiser,, 6th edition, Tata McGraw- Hill, 2009 (T3)

Reference books:

1. Fundamentals of Physics, Halliday, Walker and Resnick (R1)

Gaps in the syllabus (to meet Industry/Profession requirements)

Introduction to Food Physics

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Application of Physics in food analysis.

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	3	3	2	1	3	1	1	1	1	1	1	1	2
CO 2	1	1	3	3	2	1	2	1	1	1	2	1	1	2	2
CO 3	1	1	2	3	2	1	2	1	1	1	2	1	2	2	2
CO 4	1	1	2	3	2	1	2	1	1	1	2	1	1	1	1
CO 5	1	1	2	1	1	3	2	1	1	1	2	1	1	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **MA 103**
Course title: **Mathematics I**
Pre-requisite(s): **Basic Calculus, Basic Algebra**
Co- requisite(s):
Credits: **L: 03 T: 01 P: 00**
Class schedule per week: **04**
Class: **B. Tech**
Semester / Level: **I/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students to understand

1.	Infinite sequences and series.
2.	Theory of matrices including elementary transformations, rank and its application inconsistency of system of linear equations, eigenvalues, eigenvectors etc.
3.	Multivariable functions, their limits, continuity, partial differentiation, properties and applications of partial derivatives.
4.	Integrals of multivariable functions viz. double and triple integrals with their applications.
5.	Properties like gradient, divergence, curl associated with derivatives of vector point functions and integrals of vector point functions.

Course Outcomes

After the completion of this course, students will be able to

CO 1	Decide the behaviour of sequences and series using appropriate tests.
CO 2	Get an understanding of partial derivatives and their applications in finding maxima -minima problems.
CO 3	Apply the principles of integral to solve a variety of practical problems in engineering and sciences.
CO 4	Demonstrate a depth of understanding in advanced mathematical topics.
CO 5	Enhance and develop the ability of using the language of mathematics in engineering.

MA 103: Mathematics I

SYLLABUS

Module1: (9L)

Sequences and Series:Sequences, Convergence of Sequence. Series, Convergence of Series, Tests for Convergence:Comparison tests, Ratio test, Cauchy's root test, Raabe's test, Gauss test, Cauchy's Integraltest, Alternating series, Leibnitz test, Absolute and Conditional Convergence.

Module2: (9L)

Matrices: Rank of a Matrix, elementary transformations, Row - reduced Echelon form. Vectors, Linear independence and Dependence of Vectors. Consistency of system of linear equations. Eigenvalues, Eigenvectors, Cayley - Hamilton theorem.

Module3: (9L)

Advance Differential Calculus:Function of several variables, Limit, Continuity, Partial derivatives, Euler's theorem forhomogeneous functions, Total derivatives, Chain rules, Jacobians and its properties, Taylorseries for function of two variables, Maxima – Minima, Lagrange's method of multipliers.

Module4: (9L)

Advance Integral Calculus:Beta and Gamma functions: definition and properties.Double integrals, double integrals in polar coordinates, Change of order of integration, TripleIntegrals, cylindrical and spherical coordinate systems, transformation of coordinates,Applications of double and triple integrals in areas and volumes.

Module5: (9L)

Vector Calculus:Scalar and vector point functions, gradient, directional derivative, divergence, curl, vectorequations and identities. Line Integral, Work done, Conservative field, Green's theorem in aplane, Surface and volume integrals, Gauss – divergence theorem, Stoke 's theorem.

Text Books:

1. Thomas' Calculusby M. D. Weir, J. Hass and F. R. Giordano 11th Edition, Pearson Educations, 2008E. **(T1)**

2. Calculus by H. Anton, I. Brivens and S. Davis,, 10th Edition, John Wiley and sons, Singapore Pte. Ltd., 2013. **(T2)**

3. Higher Engineering Mathematics, Ramana B.V. Tata McGraw Hill New Delhi, 11thReprint, 2010. **(T3)**

Reference Books:

1. Calculus, by M. J. Strauss, G. L. Bradley And K. J. Smith, 3rd Ed, Dorling.Kindersley (India) Pvt. Ltd. (P Ed), Delhi, 2007. **(R1)**
2. Linear Algebra and its Applications by David C. Lay, , 3rd Edition, Pearson Ed. Asia, IndianReprint, 2007. **(R2)**
3. Advanced Engineering Mathematics by D. G. Zill and W.S. Wright, 4th Edition, 2011. **(R3)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Computer aided mathematical application in Food Industry

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Software and programming used in food sector for different calculations.

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	2	3	2	1	3	1	1	0	1	1	1	1	2
CO 2	1	1	2	3	2	1	2	1	1	0	1	2	1	1	2

CO 3	2	2	2	3	3	1	3	1	1	0	1	2	1	1	2
CO 4	2	1	2	3	2	1	2	1	1	0	1	2	1	1	2
CO 5	1	1	1	3	2	2	2	2	1	0	3	3	1	1	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD 3, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **CS 101**
Course title: **Programming for Problem Solving**
Pre-requisite(s):
Co- requisite(s): **Programming for Problem Solving Lab**
Credits: **L: 03 T: 01 P: 00**
Class schedule per week: **04**
Class: **B. Tech**
Semester / Level: **I/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To learn computer language.
2.	To learn coding for solving scientific and engineering problems.
3.	To learn the problem-solving process through computer.
4.	To know the limitations of system during program execution.
5.	To know the practical application of various programming techniques.

Course Outcomes

After the completion of this course, students will be able to

CO 1	To formulate simple algorithms for arithmetic and logical problems.
CO 2	To translate the computer algorithms to computer programs.
CO 3	To test and execute the programs and correct syntax and logical errors.
CO 4	To apply programming to solve simple numerical method problems, differentiation of function and simple integration.
CO 5	To decompose a problem into functions and synthesize a complete program using divide and conquer approach.

CS 101: Programming for Problem Solving
SYLLABUS

Module1: (9L)

Introduction to Programming: Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.) Problem Solving: Steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code

Module2: (9L)

Arithmetic expressions and precedence, Conditional Branching and Loops, Writing and evaluation of conditionals, Iterations, Loops.

Module3: (9L)

Array, Character array, strings. Case studies to discuss the various Problems related to Basic science (Matrix addition, Matrix-matrix multiplication, Roots of an equation etc.), Sorting, Searching.

Module4: (9L)

Functions (including using built in libraries), Parameter passing in functions, call by value, call by reference. Passing arrays to functions, Recursion (Finding Factorial, Fibonacci series, Ackerman function etc.).

Module5: (9L)

Structures, Defining structures and Array of Structures Pointers: Defining pointers, Use of Pointers in self-referential structures, File Handling

Text Books:

1. Problem solving and Program design in C by Jery R Hanly, 7thEdition, Pearson Education. Programming in ANSI C, Tata McGraw-Hill.
2. ReemaThareja, Introduction to C Programming by E. Balaguruswamy, 2nd Edition, Oxford University Press, 2015.
3. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie, Prentice.Byron Schaum's Outline of Programming with C Gottfried,, Tata McGraw-Hill.

Reference Books:

1. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
2. A.R. Bradley, "Programming for Engineers", Springer, 2011
3. Kernighan and Ritchie, "The C Programming Language", (2nd ed.) Prentice Hall, 1988

Gaps in the syllabus (to meet Industry/Profession requirements)

Computer application in Food Industry

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Software and programming used in food sector.

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	1	1	3	2	1	1	3	2	2	1	3	1	1	2
CO 2	1	0	2	1	2	1	2	3	2	1	1	3	1	1	2
CO 3	2	0	2	3	2	1	2	3	1	0	1	2	1	1	2
CO 4	1	1	3	3	3	2	2	3	1	1	1	2	1	1	2
CO 5	2	1	1	1	1	1	1	3	2	1	1	2	1	1	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

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CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **BE 203**
Course title: **Microbiology**
Pre-requisite(s): **Intermediate level Physics, Chemistry & Mathematics**
Co- requisite(s):
Credits: **L: 03 T: 00 P: 00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **II/01**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To develop fundamental understanding of the microbial world, basic structure and functions of microbes, metabolism, nutrition, their diversity, physiology and relationship to environment and human health.
2.	To explain the basic microbial structure , function and study the comparative characteristics of prokaryotes and eukaryotes
3.	To develop the knowledge of different culture media composition, its applications and preparation and demonstrate various physical and chemical means of sterilization
4.	To apply general bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi and algae
5.	To relate the microbial growth , pathways and associated control parameters
6.	To solve the problems in microbial infection and their control.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to develop the knowledge in the basic area of Microbiology
CO 2	Able to explain the basic microbial structure , function and study the comparative characteristics of prokaryotes and eukaryotes
CO 3	Able to formulate various culture media and have understanding of their applications
CO 4	Able to explain various physical and chemical means of sterilization
CO 5	Able to build knowledge on general bacteriology and microbial techniques for isolation of pure cultures of bacteria, fungi & algae and able to understand the microbial growth , pathways and associated control parameters

BE203 MICROBIOLOGY

Syllabus

Module-I
Brief history on the development and scope of microbiology, Methods in Microbiology-Microscopy, Methods of sterilization; culture media, Pure culture methods, Staining of Bacteria, Micrometry, Air sampling, Classification of microorganisms

Module-II
Cell structure and major characteristics of cellular (bacteria, fungi, algae, protozoa) and acellular (viruses) organisms, Archaebacteria, Growth of Microorganisms: Nutritional and physical requirements, Batch culture, Continuous culture, Synchronous growth, Fed-batch culture

Module-III
Environmental & Industrial Microbiology: Water treatment, Bacteriological analysis of water, Bioleaching, Bioremediation, Industrially important micro-organisms and secondary metabolites.

Module-IV
Agricultural Microbiology: Plant-microbial interactions, Biodeterioration of agricultural products, control of microbes and safe storage of agricultural products/food.

Module-V
Medical Microbiology: Microbial flora of healthy human host, host-pathogen interactions in animals, Diseases caused by bacteria, virus, fungi and protozoans; natural resistance and nonspecific defense mechanisms.

Text books:
Prescott, Harley, and Klein, Microbiology, 7th Ed., Tata McGraw-Hill, 2008

Reference books:
Pelczar, Chan and Krieg, Microbiology, 5th Edition, Tata McGraw-Hill, 1986
Frazier and Westhoff, Food Microbiology, 4th Edition, Tata McGraw-Hill, 1995

Gaps in the syllabus (to meet Industry/Profession requirements)

Microbial hazards in Food Industry

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Critical microbes in food applications.

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	1	2	2	3	2	2	1	1	3	3	2	3	3	3
CO 2	3	2	2	3	3	1	2	1	1	2	2	2	3	3	3
CO 3	3	1	2	3	3	3	2	1	2	3	3	2	3	3	3
CO 4	3	3	2	3	3	3	3	1	2	3	2	2	3	3	3
CO 5	3	2	2	2	3	3	2	2	2	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code:	**PH 114**
Course title:	**Physics Lab**
Pre-requisite(s):	**Intermediate Physics (Theory and Lab)**
Co- requisite(s):	
Credits:	**1.5 L:O T: 00 P: 03**
Class schedule per week:	**03**
Class:	**B. Tech**
Semester / Level:	**I/01**
Branch:	**All**
Name of Teacher:	

List of Experiments

1. Error analysis in Physics Laboratory
2. To determine the frequency of AC mains with the help of sonometer
3. To determine the wavelength of sodium light by Newton's rings Method
4. To determine the resistance per unit length of a Carey Foster's bridge wire and then to find the resistivity of the material of a given wire.
5. Measurement of mechanical equivalent of heat by electrical method
6. Determination of refractive index of the material of a prism using spectrometer and sodium light
7. To determine the frequency of electrically maintained tuning fork by Melde's experiment
8. Measurement of voltage and frequency of a given signal using cathode ray oscilloscope
9. To determine the wavelength of prominent spectral lines of mercury light by a plane transmission grating using normal incidence
10. To determine the electromotive force (emf) of an unknown cell using a stretched wire potentiometer
11. To study the frequency response and quality factor of series LCR circuit.
12. To find the specific rotation of sugar solution by using a polarimeter.
13. To determine the Hall voltage and calculate the Hall coefficient and carrier concentration of a semiconductor sample

Text books:

4. Optics, by A. Ghatak, 4th Edition, Tata Mcgraw Hill, 2009 (T1)
5. Elements of Electromagnetics by Mathew N.O. Sadiku,, Oxford University Press, 2001 (T2)
6. Concept of Modern Physicsby Arthur Beiser,, 6th edition, Tata McGraw- Hill, 2009 (T3)

Reference books:

2. Fundamentals of Physics, Halliday, Walker and Resnick (R1)

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															

CO5														

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors		
CD2	Tutorials/Assignments		
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code:	**CS 102**
Course title:	**Programming for Problem Solving Lab**
Pre-requisite(s):	**Intermediate Physics (Theory and Lab)**
Co- requisite(s):	**Programming for Problem Solving**
Credits:	**1.5 L: 00 T: 00 P: 03**
Class schedule per week:	**03**
Class:	**B. Tech**
Semester / Level:	**I/01**
Branch:	**All**
Name of Teacher:	

Sample Program List

Module 1 & Module 2: Introduction and Control Flow

1. Write an interactive program that will read in a +ve integer value and determine the following
   i) If the integer is a prime number
   ii) If the integer is a Fibonacci number
2. WAP in C to compute sinx = x – x3/3! + x5/3! – x7/7! ….. to five place of accuracy. Test the program for x = 1, x = 2, and x = 3. In each case display the number of terms used to obtain the final answer.
3. WAP to generate every 3rd integer beginning with I = 2 and continue for all integers that are less than 150. Calculate the sum of those integers that are evenly divisible by5.
4. WAP to find whether a given year is a leap year or not. Modify it to generate a list of leap years between two year limits given by user.
5. WAP to display the following pattern :

```
                    11
            11      10      11
    11      10  9   8   9   10      11
```

6. Using Ternary Operator / Conditional operator find the greatest Among 3 numbers.
7. WAP to convert a decimal number into an equivalent number of the input base. Test your program for base 2, 8 & 16.
8. WAP to read a number n, and print it out digit-by-digit, as a series of words. For e.g. 123 would be printed as “one two three”.
9. WAP to check whether any input +ve integer is palindrome or not.
10. WAP to simulate a simple calculator (+ - / * %) that takes two operands and an operator as input and displays the result.
11. WAP to find the GCD of two input +ve integer numbers. Using this find GCD of 9 numbers.
12. WAP to swap the values of two variables without using a third variable.

Module 3: Array

13. Read a line of mixed text, and then write it out with all lower case and uppercase letters reversed, all digits replaced by 0s and all other characters (non-letters and nondigits) replaced by '*'.
14. WAP to find the product of two matrices A and B. Display the source matrices and product matrix C in matrix format.
15. WAP to find whether a given matrix is a triangular matrix or not.
16. WAP to find the transpose of a matrix. Display the source and the transposed matrix in matrix format.
17. Implement Prob. No. – 14 to 16 using functions for reading, manipulating and displaying the corresponding matrices in matrix form.
18. WAP to sort a list of strings alphabetically using a 2-dim. Character array.
19. WAP to display the row sum and the column – sum of an input 2- dim. Matrix. Display the source matrix with row and column sum.

Module 4: Functions, Pointer & String

20. Write a recursive function to calculate S = 2 + 4 + 6 + 8 + …… +2N. Implement the function in a complete C program.
21. Write a function that accepts two arguments an array and its size n. It performs Bubble up sort on the array elements. Using indirection operator '*' implement this in a complete C program. Display the source and the sorted array.
22. Using pointer, write a function that receives a character string and a character as argument. Delete all occurrences of this character in the string. The function should return corrected string with no holes.
23. Write a function for reading character string using pointer. Calculate the length of the string (without using strlen ()). Finally print the string in reverse order, using pointer.
24. Implement prob. No. 14 using pointers representation of 2 – dim. array.
25. Implement prob. No. 15 using pointer representation of 2 dim. array.
26. Implement prob. No. 16 using pointer representation of 2 dim. array.
27. WAP to sort a list of strings into alphabetical order using array of pointers.

Module 5: Structure and File

28. Create records of 60 students, where each record has fields-name, roll, GPA and fees. Write a function update () to reduce the fees of those students who have obtained GPA greater than 8.5 by 25% of the original fees. Write a complete program to exercise this function in the main program and display all the records before and after updation.
29. Define a structure that describes a hotel. It should have members that include the name, address, grade, average room charge and number of rooms. Write a function to perform the following operations:
a) To print out hotels of a given grade in order of charges.
b) To print out hotels with room charges less than a given value.
30. WAP to concatenate the contents of two files into a third file.

31. WAP to copy the content of one file into another file. Names of both the files are to be input as command line arguments

Text Books:

4. Problem solving and Program design in C by Jery R Hanly, 7thEdition, Pearson Education. Programming in ANSI C, Tata McGraw-Hill.
5. ReemaThareja, Introduction to C Programming by E. Balaguruswamy, 2nd Edition, Oxford University Press, 2015.
6. The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie, Prentice.Byron Schaum's Outline of Programming with C Gottfried,, Tata McGraw-Hill.

Reference Books:

4. R. G. Dromey, "How to Solve It By Computer", Pearson, 1982
5. A.R. Bradley, "Programming for Engineers", Springer, 2011
6. Kernighan and Ritchie, "The C Programming Language", (2nd ed.) Prentice Hall, 1988

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

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CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **CE101**
Course title: **Environmental Science**
Pre-requisite(s): **NA**
Co- requisite(s): **NA**
Credits: **L:2 T:0 P:0**
Class schedule per week: **02**
Class: **B. Tech**
Semester / Level: **II/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students:

1	To develop basic knowledge of ecological principles and their applications in environment.
2	To identify the structure and composition of the spheres of the earth, the only planet sustaining life.
3	To analyse, how the environment is getting contaminated and probable control mechanisms for them.
4	To generate awareness and become a sensitive citizen towards the changing environment.
5	To critically think for environmental problem solving.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to explain the structure and function of ecosystems and their importance in the holistic environment.
CO 2	Able to identify the sources, causes, impacts and control of air pollution.
CO 3	Able to distinguish the various types of water pollution happening in the environment and understand about their effects and potential control mechanisms.
CO 4	Able to judge the importance of soil, causes of contamination and need of solid waste management.
CO 5	Able to predict the sources of radiation hazards and pros and cons of noise pollution.

CE101: Environmental Science

Syllabus

Module 1: (6L)

Ecosystem and Environment: Concepts of Ecology and Environmental science, ecosystem: structure, function and services, Biogeochemical cycles, energy and nutrient flow, ecosystem management, fate of environmental pollutants, environmental status and reports on climate change.

Module 2: (6L)

Air Pollution: Structure and composition of unpolluted atmosphere, classification of air pollution sources, types of air pollutants, effects of air pollution, monitoring of air pollution, control methods and equipment for air pollution control, vehicular emissions and control, indoor air pollution, air pollution episodes and case studies.

Module 3: (6L)

Water Pollution: Water Resource; Water Pollution: types and Sources of Pollutants; effects of water pollution; Water quality monitoring, various water quality indices, water and waste water treatment: primary, secondary and tertiary treatment, advanced treatments (nitrate and phosphate removal); Sludge treatment and disposal.

Module 4: (5L)

Soil Pollution and Solid Waste Management: Lithosphere – composition, soil properties, soil pollution, ecological & health effects, Municipal solid waste management – classification of solid wastes, MSW characteristics, collection, storage, transport and disposal methods, sanitary landfills, technologies for processing of MSW: incineration, composing, pyrolysis.

Module 5: (5L)

Noise pollution & Radioactive pollution:Noise pollution: introduction, sources: Point, line and area sources; outdoor and indoor noise propagation, Effects of noise on health, criteria noise standards and limit values, Noise measurement techniques and analysis, prevention of noise pollution; Radioactive pollution: introduction, sources, classification, health and safety aspects, Hazards associated with nuclear reactors and disposal of spent fuel rods-safe guards from exposure to radiations, international regulation, Management of radioactive wastes.

Text books:

1. Environmental Chemistryby A, K. De. (3rd Ed). 2008.. New Age Publications India Ltd.
2. Environmental Studies: From Crisis to Future byR. Rajagopalan.2016 3rd edition, Oxford University Press.
3. Fundamentals of Ecology by Eugene P. Odum. 1971. 3rd ed.- WB Sunders Company, Philadelphia.

4. Chemistry for Environmental Engineering and Science by C. N. Sawyer, P. L. McCarty and G. F. Parkin. 2002. John Henry Press.
5. Environmental Scienceby S.C. Santra. 2011. New Central Book Agency.

Reference books:

1. Basic Concepts of Environmental Chemistry by D.W.Conell., CRC Press.
2. Environmental Engineering by Peavy, H.S, Rowe, D.R, Tchobanoglous, G., Mc-Graw - Hill International
3. Introduction to Environmental Engineering and Scienceby G.M. Masters& Wendell Ela. 1991., PHI Publishers.

Gaps in the syllabus (to meet Industry/Profession requirements)

Introduction to industrial waste management

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Introduction to food industrial waste management and utilization

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	2	1	1	2	1	1	2	1	3	3	3	2	1	1
CO 2	1	2	1	1	2	1	1	2	1	3	3	3	2	1	1
CO 3	1	2	1	1	2	3	2	2	1	3	3	2	3	1	2
CO 4	2	2	1	1	2	3	1	2	1	3	3	3	2	2	1
CO 5	3	2	3	3	3	3	2	3	3	3	3	3	2	3	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **CH 101**
Course title: **Chemistry**
Pre-requisite(s): **Intermediate level chemistry**
Co- requisite(s):
Credits: **L: 03 T: 01 P: 00**
Class schedule per week: **04**
Class: **All**
Semester / Level: **II/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To create concept of Chemical bonding & Coordination Chemistry.
2.	To understand the basic 3D structure in organic chemistry including stereochemistry, aromaticity and reaction mechanism.
3.	To understand the reaction dynamics and to know different types of catalysis.
4.	To understand the modern techniques related to spectroscopy and structural characterization.
5.	To develop knowledge on the physical state and electrochemistry of molecules.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to explain the bonding in a molecular structure.
CO 2	Able to explain the 3D structure, aromaticity and stereochemistry of organic molecules.
CO 3	Able to explain the spectroscopic data for structural characterization of the molecules.
CO 4	Able to predict the rate, molecularity and mechanism of a simple as well as catalytic reaction.
CO 5	Able to interpret the phases of solid and the electrochemical behavior of the molecules.

CH 101: Chemistry

SYLLABUS

Module1: (9L)
Chemical BondingIonic bond: Radius ratio rule, Born-Landé equation, Born-Haber cycle. Metallic Bond:valence bond and band theories, defects in solids, Werner's Theory, Bonding in Transitionmetal complexes, Ligands, coordination complexes, Ligand Field, Crystal Field Theory,Octahedral, Tetrahedral and square planar complexes, CFSE, Jahn Teller theorem, electronic spectra, magnetism, and isomerization in coordination compounds.

Module2: (9L)
Organic Structure and Stereochemistry Covalent bond: Lewis structure, Valence Bond theory, Molecular orbital theory, Molecular orbital of diatomic and polyatomic system, hybridization, conjugated molecules, Huckel molecular orbital theory of conjugated systems. Isomerism, Geometrical isomerism: cis–trans and syn-anti isomerism; Optical isomerism & Chirality; Wedge, Fischer, Newmann and Sawhorse Projection formulae and interconversions; E/Z, D/L, R/S nomenclature system; Conformational studies of ethane, n-butane, Cyclohexane.

Module3: (9L)
Kinetics and Catalysis: Order & molecularity of reactions: chain, parallel, Competing, Side, Consecutive reactions; Kinetics of Fast reactions, Characteristics of catalyst, types of catalysis, catalytic poison; Theories of catalysis; Acid base catalysis: including kinetics, Enzyme catalysis, Mechanism and kinetics of enzyme catalyzed reaction, Michaelis-Menten equation, Important catalysts in industrial processes; Hydrogenation using Wilkinsons catalyst, Hydroformylation by using Cobalt-catalyst, Phase transfer catalyst.

Module4: (9L)
Spectroscopic Techniques Absorption and emission Spectroscopy, Lambert-Beers Law, Principles and applications of UV-Visible, Factors influencing for UV-VIS spectrum; Rotational and Vibrational spectroscopy, Principle of FT-IR, and NMR spectroscopy; Modern techniques in structural elucidation of compounds by UV-VIS, IR, & NMR Spectroscopy.

Module5: (9L)
Phase and Chemical equilibrium Phase Rule: Terms Involved, Phase diagram of one component (Water) & two component (Pb/Ag) system & their applications. Law of chemical equilibrium, equilibrium constants and their significance, Weak and strong electrolytes, Standard electrode potential and its application to different kinds of half cells, EMF and its measurement and application, Batteries and Fuel Cells, Chemical and Electrochemical corrosion, Factors affecting the rate of corrosion.

Text books:

1. Inorganic Chemistry: Principles of Structure and Reactivity by Huheey, J. E.,, 4th edition, Pearson.**(T1)**
2. Organic Chemistry by Morrison, R. N. & Boyd, R. N., Seventh Edition, Pearson**(T2)**
3. Physical Chemistry by Atkins, P. W. & Paula, J., 10th Ed., Oxford University Press,2014. **(T3)**

Reference books:

1. Concise Inorganic Chemistry by Lee, J. D. ELBS, 1991.**(R1)**
2. Physical Chemistry by Mortimer, R. G. 3rd Ed., Elsevier (2009). **(R2)**
3. Organic Spectroscopy by William Kemp, 3rd Ed., 2008 Macmillan. **(R3)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Introduction to Food Chemistry

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Introduction to Analytical tools in food chemistry

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	1	1	1	2	2	2	1	1	1	1	1	1	1
CO 2	1	1	1	1	1	2	2	2	1	1	1	1	1	2	1
CO 3	2	1	1	3	3	1	1	1	2	1	1	1	1	1	1
CO 4	1	1	1	1	2	2	2	2	1	1	1	1	1	1	1

CO 5	1	1	2	3	3	2	2	2	1	1	1	2	1	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **MA 107**
Course title: **Mathematics II**
Pre-requisite(s): **Mathematics - I**
Co- requisite(s):
Credits: **L: 03 T: 01 P: 00**
Class schedule per week: **04**
Class: **All**
Semester / Level: **II/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students to understand:

1.	Various methods to solve linear differential equations of second and higher order.
2.	special functions viz. Legendre's and Bessel's and different properties associated with them.
3.	Diverse mathematical techniques for solving partial differential equations of first order and higher order, along with their applications in wave and heat equations using Fourier series.
4.	The theory of functions of a complex variable, complex differentiation and integration.
5.	About random variables and elementary probability distribution.

Course Outcomes

After the completion of this course, students will be:

CO 1	Investigate the occurrence of differential equations in science and engineering and use methods available for their solutions.
CO 2	Gain an understanding on complex variable functions and using their properties in real life problems.
CO 3	Construct appropriate probability models in solving real world problems.
CO 4	Demonstrate a depth of understanding in advanced mathematical topics.
CO 5	Enhance and develop the ability of using the language of mathematics in engineering.

MA 107: Mathematics II
SYLLABUS

Module1: (9L)
Ordinary Differential Equations – I Linear differential equations, Wronskian, Linear independence and dependence of solutions,Linear differential equations of second and higher order, Operator method, Legendre's and Euler – Cauchy's form of linear differential equation, Method of variation of parameters.

Module1I: (9L)
Ordinary Differential Equations – II: Ordinary and singular points of differential equation, Power and Frobenius series solutions. Bessel's differential equation, Bessel function of first kind and its properties. Legendre's differential equation, Legendre's polynomial and its properties.

Module1I: (9L)
Fourier series and Partial Differential Equations Fourier series: Euler formulae for Fourier series, Dirichlet conditions, Half range Fourier series. Partial Differential Equations: Linear partial differential equations, Lagrange's method. Method of separation of variables and its application in solving one dimensional wave and heat equations.

Module IV: (9L)
Complex Variable-Differentiation & Integration Function of a complex variable, Limit, Continuity, Differentiability, Analyticity, Analytic functions, Cauchy – Riemann equations. Harmonic functions, Harmonic Conjugate. Cauchy's theorem, Cauchy's Integral formula, Taylor and Laurent series expansions. Singularities and its types, Residues, Residue theorem.

Module 5: Applied Probability(9L)
Discrete and continuous random variables, cumulative distribution function, probability mass and density functions, expectation, variance, moment generating function. Introduction to Binomial, Poisson and Normal Distribution.

Text Books:

1. Advanced Engineering Mathematics by E. Kreyszig,, 9th Edition, John Wiley & Sons, 2006.**(T1)**
2. Advanced Engineering Mathematics by D. G. Zill and W.S. Wright,, 4th Edition, 2011.
3. JComplex Variables and Applications, by W. Brown and R. V. Churchill, 7th Edition, McGraw Hill, 2004. **(T2)**
4. Advanced Engineering Mathematics by R.K. Jain and S.R.K. Iyengar, 3rd Edition, NarosaPublishing, 2009.**(T3)**
5. Probability and Statistics for Engineers by R. A . Johnson, I. Miller and J. Freund:, PHI.**(T4)**

Reference Books:

1. Elementary Differential Equations and Boundary Value Problems by W. E. Boyce and R. C. DiPrima, 9th Edition ., Wiley India, 2009.**(R1)**
2. A text book of Engineering Mathematics by N.P. Bali and Manish Goyal, Laxmi Publications, Reprint, 2008. **(R2)**
3. An Introduction to Ordinary Differential Equations by E. A. Coddington, Prentice Hall India, 1995. **(R3)**
4. Differential Equations with Applications and Historical Notes by G. F. Simmons,, TMH, 2nd Edition, 2003.**(R4)**
5. Introductory Probability and Statistical Applications by P. L. Meyer:, Oxford & IBH.**(R5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Computer aided mathematical application in Food Industry

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Software and programming used in food sector for different calculations.

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –
1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	2	3	3	1	2	2	1	1	1	1	1	1	1
CO 2	1	1	1	2	3	2	1	1	1	1	1	1	1	1	1
CO 3	2	1	1	2	1	2	0	2	1	1	1	1	1	1	1
CO 4	1	1	2	2	1	1	2	1	1	1	1	2	1	1	1

CO 5	2	1	3	3	2	1	2	3	1	1	2	1	1	1	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **MT 123**
Course title: **Business Communication**
Pre-requisite(s): **NIL**
Co- requisite(s): **NIL**
Credits: 3 **L: 2 T: 0 P: 1**
Class schedule per week: **3**
Class: **All**
Semester/Level: **II/ II**
Name of Teacher:

Course Objectives

This course enables the students:

A.	To analyze and demonstrate writing and speaking processes through invention, organization, drafting, revision, editing, and presentation.
B.	To understand the importance of specifying audience and purpose and to select appropriate communication choices.
C.	To interpret and appropriately apply modes of expression, i.e., descriptive, expositive, Narrative, scientific, and self-expressive, in written, visual, and oral communication
D.	To participate effectively in groups with emphasis on listening, critical and reflective thinking, and responding.
.E	To develop the ability to research and write a documented paper and/or to give an oral presentation.

Course Outcomes

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

1.	Apply business communication strategies and principles to prepare effective communication for domestic and international business situations.
2.	Utilize analytical and problem-solving skills appropriate to business communication.
3.	Participate in team activities that lead to the development of collaborative work skills.
4.	Select appropriate organizational formats and channels used in developing and presenting business messages
5.	Communicate via electronic mail, Internet, and other technologies and deliver an effective oral business presentation.

MT 123: Business Communication
Syllabus

Module I

Introduction to Business Communication: Importance and Objectives of Business communication, Process of communication, Barriers to effective communication, Techniques of effective communication. Forms of communication (Written, Oral, audio-visual communication).

Module II

Managing Business Communication: Formal and Informal communication, Non- verbal communication (Body language, Gestures, Postures, Facial expressions). The cross cultural dimensions of business communication. Techniques to effective listening, methods and styles of reading.

Module III

Other aspects of communication: Vocabulary: Single word substitution, Idioms and phrases, Precis writing, Comprehension. Group Discussions, Extempore, Principles of effective speech and presentations, Role playing.

Module IV:

Introduction to managerial writing: Business letters: Inquiries, Circulars, Quotations, Orders, Acknowledgement, Claims & adjustments, Collection letters, Sales letters, Drafting of different resumes, Covering letters Applying for a job, Social correspondence, Invitation to speak. Official Correspondence: Memorandum, Notice, Agenda, Minutes, Circular letters.

Module V:

Report writing: Business reports, Types, Characteristics, Importance, Elements of structure, Process of writing, Order of writing, the final draft, check lists for reports.

Text Books:

1. Communication Skills, Sanjay Kumar &PushpLata, Oxford University Press (T1).
2. Business Correspondence and Report Writing,R.C.Sharma, Krishna Mohan.Mcgraw Hill (T2).
3. Communication for Business,Shirley Taylor, V.Chandra, Pearson (T3).

Reference Book:

1. Business Communication- HorySankar Mukherjee, Oxford University Press (T4).
2. Basic Business Communication- .Lesikar I Flatley, McGraw Hill. (T5).
3. Business Communication Today ,Bovee, Thill and Chaterjee, Pearson (T6).

Gaps in the syllabus (to meet Industry/Profession requirements)

Business project report presentation

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design
Business project report preparation

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	2	2	3	2	2	1	2	1	3	1	3	2	1	2
CO 2	2	2	1	2	3	2	1	2	2	3	2	3	2	1	2
CO 3	2	3	2	3	1	3	1	2	1	2	1	3	2	1	2
CO 4	1	2	2	2	1	1	2	1	1	2	2	2	2	1	2
CO 5	2	3	1	2	2	3	1	3	3	3	1	3	2	1	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD	CO1	CD1, CD2, CD8

	projectors/OHP projectors		
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **EC 101**
Course title: **Basics of Electronics & Communication Engineering**
Pre-requisite(s): **Intermediate level Physics, Chemistry & Mathematics**
Co- requisite(s):
Credits: **L: 03 T: 01 P: 00**
Class schedule per week: **04**
Class: **B. Tech**
Semester / Level: **II/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand PN Junction, diodes and their applications.
2.	To comprehend BJT, FET and their bias configurations.
3.	To grasp importance of feedback in amplifier circuits, op amp and its applications.
4.	To understand number system, Logic Gates and Boolean algebra.
5.	To apprehend fundamentals of communication technology.

Course Outcomes

After the completion of this course, students will be:

CO 1	Explain PN Junction, diodes and their applications.
CO 2	Appraise the BJT, FET and their biasing techniques.
CO 3	Comprehend feedback in amplifier circuits, op amp and its applications.
CO 4	Translate one number system into another, build circuits with Logic Gates, electronic components and OPAMP IC 741 and analyze the measurement results using CRO.
CO 5	Appraise the fundamentals of communication technology.

EC 101: Basics of Electronics & Communication Engineering

SYLLABUS

Module1: (9L)

Diodes and Applications: Introduction to PN junction diodes; Characteristics of semiconductordiodes: V-I characteristics, diode-resistance, temperature-dependence, diode-capacitance; DC &AC load lines; Breakdown Mechanisms; Zener Diode – Operation and Applications; Diode as aRectifier: Half Wave and Full Wave Rectifiers with and without C-Filters.

Module2: (9L)

Bipolar Junction Transistors (BJT): PNP and NPN Transistors, Basic Transistor Action, Inputand Output Characteristics of CB, CE and CC Configurations, dc and ac load line analysis, operating point, Transistor biasing: Fixed bias, emitter bias/self-bias, Low-frequency response ofCE amplifier.Field Effect Transistors: JFET, Idea of Channel Formation, Pinch-Off and saturation Voltage,Current-Voltage Output Characteristics; MOSFET: Basic structure, operation and characteristics.

Module3: (9L)

Sinusoidal Oscillators: Concept of positive and negative feedback, Barkhausen criterion forsustained oscillations, Determination of Frequency and Condition of oscillation, Hartley andColpitt's oscillator.Operational Amplifiers: Characteristics of an Ideal and Practical Operational Amplifier (IC 741),Inverting and non-inverting amplifiers, Offset error voltages and currents; Power supplyrejection ratio, Slew Rate and concept of Virtual Ground, Summing and Difference Amplifiers,Differentiator and Integrator, RC phase shift oscillator.

Module4: (9L)

Logic Gates and Boolean algebra: Introduction to Boolean Algebra and Boolean operators,Symbolic representation, Boolean algebraic function and Truth table of different Digital logic, Gates (AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR); Realization of Basic logic gatesusing universal gates, Adder, Subtractor, adder/subtractor.

Module5: (9L)

Electronic communication: Introduction to electronic communication system, ElectromagneticCommunication spectrum band and applications, Elements of Electronic CommunicationSystem; Merits and demerits of analog and digital communication, Modes of communication;Signal radiation and propagation; Need for modulation; Introduction to Amplitude modulationand Angle modulation.

Text Books:

1. Integrated Electronics: Analog and Digital Circuits and Systems by Millman J., Halkias C.C., Parikh Chetan,, 2nd Edition, Tata McGraw-Hill.
2. Digital Logic and Computer Design by Mano M.M., Pearson Education, Inc, Thirteenth Impression, 2011.

3. Analog and Digital Communications by Singal T. L.,, 2nd Edition, Tata McGraw-Hill.
4. Introduction to Analog & Digital Communications by Haykin S., Moher M., 2nd Edition, Wiley India Pvt. Ltd.

Reference Book:

1. Electronic Devices and Circuit Theory by Boylstead R.L., Nashelsky L.,, 10th Edition Pearson Education, Inc.

Gaps in the syllabus (to meet Industry/Profession requirements)

Basic electronic applications in food

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Basic electronic based sensors in food applications in

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	1	1	2	2	2	3	1	1	1	2	1	1	1	1
CO 2	1	1	1	2	2	2	3	1	1	1	2	1	1	1	1
CO 3	1	1	1	2	2	2	3	1	1	1	2	1	1	1	1
CO 4	2	2	1	2	3	2	2	3	1	1	2	1	1	1	1
CO 5	1	1	1	1	2	2	2	1	1	2	1	3	1	1	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
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CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **BE 201**
Course title: **Microbiology Lab**
Pre-requisite(s):
Co- requisite(s): **Microbiology**
Credits: 1.5 **L: 00 T: 00 P: 03**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **II/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand terms and safety procedure of microbiological applications.
2.	To know microscopy techniques, media preparation & methods of inoculation of different microbes
4.	To grasp the knowledge of Pure Culture Techniques like streak plate method, pour plate method.
5.	To understand the fundamentals of identification of microbes by use of staining methods

Course Outcomes

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

CO 1	Explain microbiological safety procedure and their applications in industry.
CO 2	Able to translate effects of microbes in human health
CO 3	Able to handle the microbiological tools and equipments.
CO 4	Able to assess the microbial quality of products by different techniques.
CO 5	Able to do Quantitative and qualitative analysis of samples for microbial test.

BE 201: Microbiology Lab

Syllabus

1. General terms and safety procedure of microbiology Laboratory
2. Microscopy- Brightfield, Darkfield Microscopy, Phase-Contrast Microscopy, Fluorescence Microscopy & Microscopic Measurements
3. Aseptic Technique- Transfer from broth culture to another broth, Transfer of bacteria from slant to slant, Working with agar plates(Inoculating a slant from a Petri plate)
4. Media preparation & methods of inoculation of different microbes in selective media.
5. Smear Preparation-from liquid and solid media
6. Pure Culture Techniques- streak plate method, pour plate method
7. Bacterial Population Counts- Quantitative plating method, Pipette Handling, Diluting and Plating Procedure
8. Identification of microorganisms from the habitats [simple staining, differential staining, acid fast staining, capsule staining, Gram staining , spore staining and motility]
9. Observation of morphology - shape and arrangement of cells.
10. Bacteria and its general properties
11. Bacteriology of air, soil and water
12. General properties of The Fungi: Yeasts and Molds
13. Study of yeast and mold
14. Motility determination-Soft agar deeps and Hanging drop method

Text books:

Prescott, Harley, and Klein, Microbiology, 7th Ed., Tata McGraw-Hill, 2008

Reference books:

Pelczar, Chan and Krieg, Microbiology, 5th Edition, Tata McGraw-Hill, 1986
Frazier and Westhoff, Food Microbiology, 4th Edition, Tata McGraw-Hill, 1995

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60

Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	3	3	3	1	3	2	2	3	3	3	3	3	3
CO2	3	1	3	3	3	1	3	2	2	3	3	3	3	3	3
CO3	3	1	3	3	3	1	3	2	2	3	3	3	3	3	3
CO4	3	2	3	3	3	1	3	2	2	3	3	3	3	3	3
CO5	3	3	3	3	3	3	3	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **CH 102**
Course title: **Chemistry Lab**
Pre-requisite(s): **Intermediate level Chemistry**
Co- requisite(s):
Credits: **1.5** **L: 0T: 00** **P: 03**
Class schedule per week: **03**
Class: **B. Tech.**
Semester / Level: **II/01**
Branch: **All**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand Quantitative and Gravimetric methods of analysis and their applications.
2.	1. To know FTIR and NMR, extraction process and analysis of compounds using FTIR and NMR
4.	To grasp the knowledge on the effect of a catalyst on the rate of reaction.
5.	To understand the fundamentals of identification and detection of special elements in organic compounds

Course Outcomes

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

CO 1	Explain the FTIR and NMR and their applications.
CO 2	Able to handle the tools and equipments used in chemical analysis.
CO 3	Able to translate effects of catalysts on the rate of chemical reactions
CO 4	Able to assess the chemical quality of products by different techniques.
CO 5	Able to do Quantitative and qualitative analysis of samples for chemical compounds.

CH 102: Chemistry Lab

Syllabus

2. Gravimetric estimation of Nickel by Dimethylglyoxime.
3. Quantitative estimation of Ca^{2+} and Mg^{2+} ions by complexometric titration using Na_2-EDTA.
4. To verify Bears Law using Fe^{3+} solution by spectrophotometer/colorimeter and to determine the concentration of a given unknown Fe^{3+} solution.
5. Separation of binary organic mixture by acid-base extraction and analysis using given FTIR and NMR spectrum.
6. Preparation of Diazoamino Benzene and report the melting point and yield of product.
7. Draw melting point-mass percent composition diagram for two component mixture and determine the Eutectic Temperature.
8. To study the kinetics of acid-catalyzed hydrolysis of ethyl acetate and to evaluate the value of the rate constant.
9. To determine the rate law for the reaction between iodide and hydrogen peroxide in anacidic environment and to determine the effect of a catalyst on the rate of reaction.
10. To determine the strength of the given strong acid by strong base Potentiometrically.
11. To determine the transition temperature of the given salt hydrate.
12. Qualitative detection of special elements in organic compounds.
13. To draw the pH-titration curve of strong acid vs strong base.

Text books:

1. Experimental Physical Chemistry, By B. Viswanathan, P. S. Raghavan, Narosa Publishing House (1997).
2. Vogels Textbook of Practical Organic Chemistry

Experiments in General chemistry, by C. N. R. Rao and U. C. Agarwal

Reference book:

1. Organic Chemistry Vol 1 and 2 by P R Singh, D S gupta, K S Bajpai, Tata McGraw Hill

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment

(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	3	3	3	3	2	2	2	3	3	2	2	2
CO2	3	2	3	3	3	3	3	2	2	2	3	3	2	2	2
CO3	2	1	2	3	3	1	3	1	2	2	3	1	2	2	2
CO4	3	1	3	3	3	3	3	2	2	3	1	1	2	2	2
CO5	3	1	3	3	3	3	3	2	2	3	1	1	2	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code:		**EC 102**
Course title:		**Electronics & Communication Lab**
Pre-requisite(s):		**Intermediate level Chemistry**
Co- requisite(s):		
Credits:	**1.5**	**L:0 T:0 P: 03**
Class schedule per week:	**03**	
Class:		**B. Tech.**
Semester / Level:		**II/01**
Branch:		**All**
Name of Teacher:		

EC 102: Electronics & Communication Lab
Syllabus

List of Compulsory experiments:

1. Measurement of voltage, time period and frequency of different signals on CRO.
2. Measurement of frequency and phase of two different signals using Lissajous pattern.
3. To determine the forward and reverse bias characteristics of PN junction diode.
4. To determine the reverse bias characteristics of Zener diode and application as a voltage regulator.
5. Measurement of rectification efficiency and ripple factor of Half-wave and Full-wave rectifierCircuits with and without C-Filter.
6. To determine the frequency response of CE transistor amplifier and finding its gain bandwidthproduct.
7. To determine the transfer characteristics of JFET and measurement of its voltage gain.
8. Design of RC phase shift oscillator using IC-741 Op-Amp and finding its frequency of oscillation.

Text Books:

1. Integrated Electronics: Analog and Digital Circuits and Systems by Millman J., Halkias C.C., Parikh Chetan,, 2nd Edition, Tata McGraw-Hill.
2. Digital Logic and Computer Design by Mano M.M., Pearson Education, Inc, Thirteenth Impression, 2011.
3. Analog and Digital Communications by Singal T. L.,, 2nd Edition, Tata McGraw-Hill.
4. Introduction to Analog & Digital Communications by Haykin S., Moher M., 2nd Edition, Wiley India Pvt. Ltd.

Reference Book:

1. Electronic Devices and Circuit Theory by Boylstead R.L., Nashelsky L.,, 10th Edition Pearson Education, Inc.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60

Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1															
CO2															
CO3															
CO4															
CO5															

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors		
CD2	Tutorials/Assignments		
CD3	Seminars		
CD4	Mini projects/Projects		
CD5	Laboratory experiments/teaching aids		
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course Code: **FT 201**
Course title: **Food Chemistry**
Pre-requisite(s): **CH 101 Chemistry**
Co- requisite(s): **FT206 Food Chemistry Laboratory**
Credits: **L: 04 T:00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To interpret chemical interactions and reactions of food components and their effect on sensory, nutritional, and functional properties of foods, and how processing influences these properties
2.	To identify the structure of food constituents and relate the structure to the constituents function and importance in foods with respect to food quality, nutrition, safety, processing, etc.
3.	To classify and compare the various food groups; the nutrient components (macro and micro), proximate composition.
4.	To explain how environmental factors such as temperature, pH, ionic characteristic and strength, bonding, light, etc. affect chemical changes in food systems and judge how to adjust these conditions to improve or minimize chemical and biochemical deterioration of food systems.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to develop the knowledge in the basic area of Food Chemistry
CO 2	Able to discover the functional role of food components and their interaction in food products in terms of colour, flavour, texture and nutrient composition
CO 3	Able to combine chemistry and biochemistry principles into real-world food science and nutritional problems
CO 4	Able to discover the functional application of major food components
CO 5	Able to predict the changes of food quality with respect to compositional change

FT 201 Food Chemistry

SYLLABUS

Module I: (9L)
Introduction to different food groups and importance of food chemistry; Proximate composition of foods; Water: Definition of water in foods, physical properties of water and ice, structure of water and ice, interaction of water with solutes, sorption phenomenon, types of water; water activity, Methods to determine moisture content in food.

Module II: (9L)
Carbohydrate: Sources of food carbohydrates, definition, classification, structure of monosaccharides, disaccharides, oligosaccharides polysaccharides (starch, glycogen, cellulose, hemi-cellulose, lignins,pectins, gums and mucilages); Chemical reactions of carbohydrates; gelatinization and retrogradation of starch, Effect of processing and storage condition on carbohydrates: Modified starches; Role of carbohydrates in the food industry. Methods to determine carbohydrate content in food.

Module III: (9L)
Fats: Sources, definition, classification, structures, physical and chemical properties of lipids and fatty acids; Effect of processing and storage on fats and oils; PUFA,hydrogenation, polymerization, polymorphism and rancidity; Crude oils refining, hydrogenation and winterization, vegetable and animal fat, margarine, lard, butters, and shortening; Saponification number, iodine value, Reichert-Meissl number, Polenske value; Biological important lipid like cholesterol and phospholipids;Methods to determine fat content in food.

Module IV: (9L)
Proteins : Sources , primary & secondary structures, amino-acids - classification, essential and non-essential amino-acids, structures and properties; Peptides -peptide bonds and some important peptides; Purification and denaturation of proteins; Protein interaction and degradation, protein-lipid complexes and protein-carbohydrate complex; Major protein systems and factors affecting them; Modified protein, important food proteins; changes of proteins on processing and storage with special emphasis on enzymatic and non-enzymatic browning such as Maillard reactions and Strecker degradation; Methods to determine protein content in food

Module V: (9L)
Enzymes**:** specificity, simple and inhibition kinetics, coenzymes, enzymatic and non-enzymatic browning, enzymes in food processing, immobilization of enzymes, removal of toxicants through enzymes.Minerals and Vitamins: Sources and structures of minerals & vitamins; Effect of processing and storage of vitamins; Pro vitamins A & D; Vitamins as antioxidants. Pigments: carotenoids, chlorophylls, anthocyanins, tannins and myoglobin. Food flavours: terpenes, esters, aldehydes, ketones and quinines. Flavor and Aroma of foods - Taste, odor, feeling, blends, control of aroma in processed food.

Text books:

1. M.S. Swaminathan. Essentials of Food & Nutrition by, Vol. 1 & 2**(T1)**
2. L. H. MuyerFood Chemistry **(T1)**
3. S. Damordaran, K. Parkin, O. Fennema Eds. CRC Press. Fennema's Food Chemistry, 2007. 4th Edition.**(T1)**
4. J. deMan. Principles of Food Chemistry, 1999. 3rd Edition. Aspen Publishers, New York. **(T1)**

Reference books:

1. S. Ranganna. Hand Book of Analysis of fruits & vegetables **(R1)**
2. Linhinger, Food Chemistry **(R2)**
3. RS Kirk and R Sawyor. Composition and Analysis of Foods, (1991). Longman Scientific and Technical, UK**(R3)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Food reactions and associated changes in food

POs met through Gaps in the Syllabus
PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Deteriorative reactions in food

POs met through Topics beyond syllabus/Advanced topics/Design
PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	3	3	1	3	1	2	1	2	1	3	3	3
CO 2	3	1	3	3	3	1	3	1	2	1	2	1	3	3	3

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

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 202**
Course title: **Introduction to Food Engineering**
Pre-requisite(s): **-**
Co- requisite(s): **-**
Credits: 3 **L: 03 T: 0 P: 00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To develop fundamental knowledge of chemical engineering for food applications
2.	To develop knowledge in dimensions, units, dimensionless ratios
3.	To interpret the principles of material and energy balance
4.	To relate the physico chemical properties of gases, liquids, solids
5.	To discover the basic of reaction kinetics and process control

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand basis of calculations pertaining to unit processes and unit operations.
CO 2	Able to perform material and energy balance for various food applications
CO 3	Able to develop knowledge in the physic-chemical properties of gases, liquids, solids
CO 4	Able to perform calculations pertaining to reaction kinetics in food application.
CO 5	Able to understand and apply the knowledge of process control in food industries

SYLLABUS

FT 202 Introduction to Food Engineering

Module I: (9L)

Units and Dimensions, Unit consistency and unit conversion, dimensional analysis, Buckingham Pi-theorem, Example of common non-dimensional parameters and their physical significance: Reynolds number, Froude number and Mach number; Concept of steady state, unsteady state, and equilibrium. Concept of system and surroundings, extensive and intensive properties, additive and non-additive properties, Graphical differentiation and graphical integration, Treatment and Interpretation of data, Error analysis in connection with computation.

Module II: (9L)

Introduction to Material Balance-Law of Conservation of Mass-total mass and component mass balance, General mass balance equation for batch, semi-batch and continuous process, Process Flow Diagrams, Material Balance problems without chemical reaction-problems involved in dilution, concentration, and dehydration, volume changes on mixing, Material Balance with chemical reaction, Material Balances with recycle, bypass and purge. Material Balance with Chemical Reaction, stoichiometry, conversion and yield of reaction.

Module III: (9L)

Ideal gas-law calculations, real-gas relationships-van der Waal's equation, Vapor pressure of liquids-Antoine's equation. vapour pressure of immiscible liquids, solutions and problems based on Raoult, Henry & Dalton's Law.Gibbs' Phase Rule, The Kinetic Theory of Gases, Absolute Temperature and Pressure, Mass and energy balance for open systems. Energy Balance for closed and open system, heat of formation, heat of vaporization, heat of fusion and sublimation, Standard heat of reaction, formation and combustion, numerical problems using Hess Law. Numerical problems using steam table.

Module IV: (9L)

Kinetics: Law of mass action, Rate of chemical reaction, Equilibrium rate constant, Le-Chatelier's principle, Effect of Temperature on Rate Constant, Arrhenius equation, Collision Theory, Transition State Theory, Order and Molecularity of a Chemical reaction, Elementary Reactions, First, Second and Third order reactions, Non Elementary Reactions, Pseudo-first order reaction, Determination of rate constant and order of reaction, Half life method, Fractional order reactions.

Module V: (9L)

Elements of Process Control: Basic control structures, Feedback control, Feed-forward control, Comparative merits of control strategies, The block diagram, Input, output and process dynamics, First order response, Second order systems , Control modes (control algorithms), On-off (binary) control, Proportional (P) control, Integral (I) control, Proportional-integral (PI) control , Proportional-integral-differential (PID) control, Physical Elements of the Control System- sensors (Temperature, pressure, flowrate, composition, level, color, shape), controllers, and actuators, Automatic control, Computer-based systems-Programmable logic controllers (PLCs).

Text books:

1. Elements of Food Engineering by R.T. Toledo, **(T1)**
2. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T2)**
3. Basic Principles and Calculations in Chemical Engineering: Himmelblau, 6th Ed. Prentice Hall **(T3)**

Reference books:

1. Chemical Process Principles by Hougen and Watson, (Part one): 2nd ed, John Wiley.**(R1)**
2. Stoichiometry by Bhatt &Vora,, 4th Ed., TM **(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Food industrial process flow and its linkage to syllabus

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Sensor applications in food industries.

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	3	3	1	3	1	2	1	3	3	3	3	3
CO 2	3	2	3	3	3	1	3	1	2	1	3	3	3	3	3
CO 3	3	2	3	3	3	1	3	1	2	1	2	2	3	3	3
CO 4	3	2	3	3	3	1	3	1	2	1	3	3	3	3	3
CO 5	3	3	3	3	3	2	3	2	1	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 203**
Course title: **Food Microbiology**
Pre-requisite(s): **Microbiology**
Co- requisite(s):
Credits: **L: 04 T: 00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1	To interpret the principles of Food Microbiology.
2.	To experiment with the microbes in relation to food spoilage, food-borne diseases and food preservation
3.	To interpret the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods.
4.	To identify ways to control microorganisms in foods.
5.	To infer the conditions under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to develop knowledge in the basic area of Food Microbiology.
CO2	Able to explain the role of microbes in food spoilage, preservation of foods and food borne infections.
CO3	Able to predict the role of microbes in health and diseases
CO4	Able to analyze and explain the characteristics of important pathogens and spoilage microorganisms in foods.
CO5	Able to develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.

SYLLABUS

Module I:

Food microbiology and its scope; History of microbiology of food; Types of microorganism normally associated with food: bacteria, fungi, yeast & mold; Characteristics of predominant microorganisms in Food: morphology of bacteria, yeast, mold and actinomycetes, spores and vegetative cells, gram-staining; Sources of microorganisms in food: Plants, Animals, Air, soil, sewage, waters, humans, food ingredient, equipment; Intrinsic and extrinsic factors on growth and response of microorganisms in foods, Microbial control, Importance of microorganism in food industry. (9L)

Module II:

Microbial growth: growth and death kinetics; Inactivation conditions for food borne pathogens and spoilage microorganisms; Thermal Process Calculations: Processes and systems for stabilization of foods for shelf-stable storage-Microbiological inactivation rates at constant temperature, effect of temperature on thermal inactivation of microorganisms, determination & importance of TDT, F, Z & D values, inactivation of microorganisms and enzymes in continuously flowing fluids; Sterilizing value of processes expressed as F_0, thermal process calculations for canned foods, broken heating curves, quality factor degradation; Factors affecting heat resistance; Pasteurization and sterilization. (9L)

Module III:

Microbiology of milk & milk products like cheese, butter, ice-cream, milk powder; Fermented milk and milk products: curd, yoghurt, cheese; Microbiology of meat, fish, poultry & egg and their products; Fermented meat, fish, and poultry products; Microbiology of fruits & vegetable and products like jam, jelly, sauce, juice; Microbiology of cereal and cereal products like bread, biscuits, confectionary; Fermented fruit, vegetable and cereal products pickles, soya-sauce, sauerkraut, idli, dosa, vinegar, alcoholic beverages.

(9L)

Module IV:

Food Contamination and Spoilage Food microbiology and public health - Food poisoning, food poisonings due to pathogens, important features - A brief account of various organisms related with food poisoning; Food Borne diseases: Toxins from microbes: pathogens and non-pathogens including Staphylococcus, Salmonella, Shigella, Escherichia, Bacillus, Clostridium, and Aspergillus genera; Beneficial roles of microorganisms: Introduction to prebiotics and probiotics. (9L)

Module V:

Fermented fish; Fermented meats; Fermented beverages: Beer, Vinegar and Wine; Production of baker's yeast, food yeast, Single cell protein, bread, beer, wine, cider, vinegar, organic acids (eg. Citric ,lactic, Acetic acids, Fumaric and Gluconic acid) and enzymes (eg. Amylases, protease, lipases, pectinases, celluloses, hemicellulose etc.). IMFL/ distilled spirits (eg. Rum, gin, whisky). Mushroom cultivation.

(9L)

Text books:

1. Essentials of Microbiology by K. S. Bilgrami; CBS Publishers, Delhi **(T1)**
2. Food Microbiology by WC Frazier; Tata McGraw Hill, Delhi**(T2)**
3. Modern Food Microbiology by James M Jay; CBS Publishers, Delhi**(T3)**
4. Food Microbiology by M. R. Adams **(T4)**

Reference books:

1. Fundamental Food Microbiology by Bibek Ray, Arun Bhunia, Fifth Edition **(R1)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Kits used for food microbial spoilage detection

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Scientific basis behind the different Kits used for food microbial spoilage detection

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	2	3	2	1	2	1	2	2	3	2	3	3	3
CO 2	3	2	2	3	2	2	3	1	2	2	3	2	3	3	3
CO 3	2	1	2	3	2	1	2	1	2	2	3	2	3	3	3
CO 4	3	1	2	3	2	1	2	1	1	1	3	2	3	3	3
CO 5	3	3	3	3	2	3	2	3	2	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code:	**FT 204**
Course title:	**Basics of Food Processing & Preservation**
Pre-requisite(s):	**BE203 Microbiology**
Co- requisite(s):	**FT 203 Food Microbiology, FT 207 Food Preservation Lab.**
Credits:4	**L:04 T:00 P:00**
Class schedule per week:	**04**
Class:	**IMSc**
Semester / Level:	**II/02**
Branch:	**Food Technology**
Name of Teacher:	

Course Objectives

This course enables the students:

1.	To develop knowledge of preserving food to prevent wastages and losses
2.	To make use of information on the scientific mechanism of food preservation
3.	To build practical knowledge to various methods of food processing.
4.	To apply variety in the diet by providing a range of attractive flavors, colors, aromas and textures in food (collectively known as eating quality, sensory characteristics or organoleptic quality)

Course Outcomes

After the completion of this course, students will be:

CO1	Able to justify the need for food processing.
CO2	Able to discover the various processing techniques.
CO3	Able to understand the various methods by which foods could be preserved.
CO4	Able to discuss on the methods to extend the shelf life to allow time for distribution, sales and home storage.
CO5	Able to measure the shelf life of the food

SYLLABUS

FT 204 Basics of Food Processing & Preservation

Module I: (9L)

Introduction to food processing: Basic principles, importance of food processing and preservation, classification of foods, types of food spoilage, viz. microbiological, enzymatic, chemical and physical spoilages and their effects on food quality; Objectives and techniques of preservation by using high temperature, using low temperature, using chemicals, and removing moisture.

Module II: (9L)

Water activity (aw) in foods: Role of water activity in food preservation, control of aw by addition of solutes and moisture removal, moisture sorption isotherm, measurements of water activity, intermediate moisture food (IMF); Processing by Moisture Removal: Evaporation, Concentration and Dehydration, Drying operation, Drying of solid and liquid foods, Types of dryers, their advantages and disadvantages, Concentration of liquid food by evaporators, Continuous, Multiple effect, Falling and rising film evaporators, Principles of freeze concentration, Membrane processes for liquid food concentration.

Module III: (9L)

High temperature processing: Principles of thermal processing, Blanching, Pasteurization and Sterilization, microbial destruction in batch and continuous sterilization, methods of heat transfer, heat resistance of micro-organisms, factors affecting heat resistance of micro-organisms, TDT curve, canning of foods, categories of foods for canning, heat penetration into food containers, calculating the process time for canned food, UHT processing, Microwave and radio frequency processing of foods.

Module IV: (9L)

Low temperature processing: refrigeration, chilling and freezing of food, freezing principles, low and fast freezing, freezing process, determining freezing load, ammonia refrigeration systems, freezing rate, estimation of freezing time of foods, Types of freezers, thawing of frozen food; Freezing damage-osmotic damage, Refrigeration, Food preservation by packaging: role, function and impact assessment, shelf life of packaged foods: factors affecting product quality and shelf life. Controlled Atmosphere Storage (CAS),Modified Atmosphere Storage (MAS).

Module V: (9L)

Food Preservation by Irradiation: Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. Food preservation by sulphating, smoking, and pickling; Food Preservation by Fermentation - Principles, Types of fermentation, Advantages Food Preservation

by Chemicals: Use of preservative in foods: Class 1 and Class II preservative, Chemical Food Preservatives & their acceptable daily intake, bio preservatives.

Text books:

1. Food Scienceby Norman, N.P. and Joseph, H.H. (1997).. Fifth edition, CBS Publication, New Delhi.**(T1)**
2. Food Microbiologyby Frazier, W.C. and Westhoff, D.C. (1996). 4th edn, Tata McGraw Hill Pvt. Ltd., New Delhi. **(T2)**
3. Food Processing Technology byFellows, P.J. (2002).: Principles and Practice, 2nd edn, Woohead Pub. Ltd. **(T3)**
4. Principles of Food Science, Part II, Physical Principles of Food Preservation by Marcel Dekker, Inc. **(T4)**
5. M. Shafeiur Rahman (1999). Handbook of Food Preservation, Marcel Dekker, Inc. **(T5)**
6. Vickie A. Valdavik and Elizabeth, W. Christian (2003). Essentials of Food Science. Springers. **(T6)**

Reference books:

1. Food storage and preservation by Vijayakhader**(R1)**
2. Food Science by B. Srilakshmi **(R2)**
3. Food Preservation by Desrosier **(R3)**
4. Physical Principles of Food Preservation Fennema **(R4)**
5. Fruit & vegetables preservation and practice by K. Sanjeev & Srivastava R.P**(R5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Industrial visit and designing of operational flow diagram of respective food industry

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent advances in non thermal preservation techniques

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	1	3	3	1	1	2	1	2	1	3	3	3	3	3
CO 2	3	1	3	3	2	2	3	1	2	1	3	3	3	3	3
CO 3	3	1	3	3	2	1	2	1	2	1	3	3	3	3	3
CO 4	3	1	3	3	1	2	2	1	2	1	3	3	3	3	3
CO 5	3	1	3	3	1	1	2	1	2	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 205**
Course title: **Introduction to Agricultural Practice**
Pre-requisite:
Co- requisite(s):
Credits: **4** **L:4T:00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**

Course Objectives

This course enables the students:

1.	To develop knowledge of physical, chemical and biological properties of different types of soils
2.	To provide information on the agricultural problems, scientific and technological methods for stabilizing agriculture production
3.	To build practical knowledge of crops, cropping patterns for different agro-climatic zones of the country.
4.	To develop knowledge of technologies for the cultivation of Seed crops and processing of Seed

Course Outcomes

After the completion of this course, students will be:

CO1	Able to justify the soils and soil conditions needed for agricultural production
CO2	Able to discover the scientific and technological methods for cultivation of various useful crops
CO3	Able to discuss on the crops, cropping patterns and their importance in agriculture
CO4	Able to evaluate the package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops
CO5	Able to understand the use of techniques by which agricultural production can be increased

SYLLABUS
FT 205 Introduction to Agricultural Practices

Module I: (9L)
Soil - physical, chemical and biological properties. Processes and factors of soil formation. Soils of India. Ecology and its relevance to agriculture, natural resources, their sustainable management and conservation. Physical and social environment as factors of crop distribution and production. cropping pattern. Environmental pollution and associated hazards to crops, animals and humans. Climate changes, Green house effect and global warming. Advance tools for ecosystem analysis.

Module II: (9L)
Principles of soil fertility, soil testing and fertilizer recommendations, integrated nutrient management. Bio-fertilizers. Soil conservation, integrated watershed management. Soil erosion and its management. Dry land agriculture and its problems. Technology for stabilizing agriculture production in rain fed areas.

Module III: (9L)
Water - use efficiency in relation to crop production, criteria for scheduling irrigations, ways and means of reducing run-off losses of irrigation water. Rain water harvesting. Drip and sprinkler irrigation. Drainage of waterlogged soils, quality of irrigation water, effect of industrial effluents on soil and water pollution. Irrigation projects in India.

Module IV: (9L)
Cropping patterns in different agro-climatic zones of the country. Impact of high yielding and short-duration varieties on shifts in cropping patterns. Concepts of various cropping and farming systems. Organic and Precision farming. Package of practices for production of important cereals, pulses, oil seeds, fibres, sugar, commercial and fodder crops. Agro forestry and value addition.

Module V: (9L)
Seeds: Seed production and processing technologies. Seed certification, seed testing and storage. DNA fingerprinting and seed registration. Role of public and private sectors in seed production and marketing. Intellectual Property Rights (IPR) issues, WTO issues and its impact on Agriculture. Weeds, their characteristics, dissemination and association with various crops; their multiplications; cultural, biological, and chemical control of weeds.

Text Books:
1. Principles of Agronomy by Yellamanda Reddy T and Sankara Reddy G H, Kalyani Publishers

Reference Books:
1. Introduction to Agriculture by A.K. Vyas and Rishi Raj.
2. Vegetable Science by Dr. Bijender Singh.

Gaps in the syllabus (to meet Industry/Profession requirements)

A outlook to fertilizer, bio fertilizer and their respective successful Indian Industries.

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

A outlook to fertilizer & bio fertilizer

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	1	2	2	2	2	1	3	2	3	1	3	1	1	2	1
CO 2	1	2	2	2	2	1	3	2	3	3	2	3	1	2	1
CO 3	1	2	2	2	2	1	3	2	3	3	2	3	1	1	1
CO 4	1	2	2	2	2	1	3	2	3	3	2	3	1	1	1
CO 5	1	3	2	3	3	3	2	2	3	3	3	3	1	2	1

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		

CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 206**
Course title: **Food Chemistry Laboratory**
Pre-requisite(s): **-**
Co- requisite(s): **FT 201 Food Chemistry**
Credits:2 **L: 00 T: 00 P: 04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**

Course Objectives
This course enables the students:

1.	Recognize the important reactions in food chemistry and their consequences.
2.	Be familiar with methods to measure these reactions.
3.	Be capable of reporting their results in an appropriate format.
4.	Be capable of designing and conducting an experiment to understand a simple food chemistry problem.

Course Outcomes

After the completion of this course, students will be:

CO1	Conduct appropriate laboratory experiments common to basic and applied food chemistry and interpret the results.
CO2	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO3	Clearly communicate research results using appropriate written, oral, and visual communication techniques.
CO4	Conduct appropriate laboratory experiments specific to particular group of food product.
CO5	Work cooperatively in a team to interpret analytical data for report preparation.

List of experiments

1. Carbohydrate – test for starch and reducing sugar
2. Maillard Browning Reaction – To evaluate the aroma and color of heated amino acid-glucose solutions
3. Ester as Food Flavorings
4. Qualitative analysis of proteins and demonstration of color reactions of proteins
5. Quantitative test for protein by Biuret Test
6. Protein Denaturation: Milk
7. Effect of pH and temperature on pigments
8. Determination of Saponification Value
9. Dietary fibres – solubility and gelling characteristics as function of temperature and pH
10. Determination of effect of temperature and antioxidation rancidity of lipids by calculating Peroxide Value
11. Estimation of ash content of food(total ash, acid soluble, insoluble ash)
12. Determination of calorific value of food sample
13. Maillard Browning Reaction
14. Structure and properties of proteins-primary structure of proteins (chromatographic method).
15. Ways of irreversible precipitation of protein from solutions.(protein denaturation)
16. Quantitative determination of ascorbic acid in various food-stuffs.

Text Book:

1. S. Ranganna, Hand Book of Analysis and Quality Control forFruits and Vegetable Products, Tata McGraw Hill, 2002.

Reference Book:

1. Winton AL (1999)Techniques of food analysis, Allied Science Publications NewDelhi.
2. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
3. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	1	1	3	2	2	3	3	3
CO2	3	3	3	3	3	3	3	2	1	3	2	2	3	3	3
CO3	2	3	3	3	3	3	3	1	3	3	2	2	3	3	3
CO4	3	3	3	3	3	3	3	1	1	3	2	2	3	3	3
CO5	3	3	3	3	3	3	3	2	1	3	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used

CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 207**
Course title: **Food Preservation Laboratory**
Pre-requisite(s): **-**
Co- requisite(s): **FT 204 Basics of Food Processing and Preservation**
Credits:2 **L: 00 T: 00 P: 04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**

Course Objectives

This course enables the students to:

1.	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
2.	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
3.	Compare and contrast conventional and emerging food processing technologies in real-life food processing
4.	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Course Outcomes

After the completion of this course, students will be:

CO1	To analyze, interpret and explain complex phenomena in context of preservation principles
CO2	To apply critical thinking skills to new food processing situations
CO3	To explain the mechanisms of spoilage and deterioration of foods and raw materials: microbial, chemical, physical, biochemical, etc.
CO4	To explain the basic principles of food preservation processes: heating, chilling, freezing, control of water activity, acidification, chemical preservatives, packaging, etc
CO5	To explain the effects of processing steps on nutritional quality, including bioactive components of foods

List of experiments

1. Preservation of liquid food by thermal processing & microbial survivor curve
2. Preservation by Fluidized bed Drying, microwave and Tray drying
3. Preservation of Drying: Spray drying & Freeze Drying.
4. Rehydration kinetics of dried products-comparison of methods of drying
5. Effect of blanching on frozen vegetable quality
6. Pasteurization of milk
7. Preservation by curing & pickling : Indian pickle preparation and quality control
8. Preservation by Osmo Drying
9. Preservation by canning
10. Preparation of fruit candy
11. Preservation by Retort processing
12. Preservation by intermediate moisture food (IMF) preparation
13. Preservation by natural and chemical preservative
14. Determination of Water Activity

Text Book:

1. S. Ranganna, Hand Book of Analysis and Quality Control forFruits and Vegetable Products, Tata McGraw Hill, 2002
2. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip, Handbook of Vegetable Preservation and Processing, Marcel Dekker,2003.

Reference Book:

1. Winton AL (1999)Techniques of food analysis, Allied Science Publications NewDelhi.
2. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
3. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)

Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	3	3	3	3	3	2	2	1	3	1	3	3	3
CO2	2	1	3	3	3	3	3	2	2	1	3	1	3	3	3
CO3	2	1	3	3	3	3	3	2	2	1	3	1	3	3	3
CO4	2	1	3	3	3	3	3	2	2	1	3	1	3	3	3
CO5	3	2	3	3	3	3	3	2	2	1	3	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 208**
Course title: **Food Microbiology Laboratory**

Pre-requisite(s): **-**
Co- requisite(s): **FT 203 Food Microbiology**
Credits: **2** **L: 00 T: 00 P: 04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **III/02**
Branch: **Food Technology**

Course Objectives

This course enables the students:

1.	Recognize and describe the characteristics of important pathogens and spoilage microorganisms in foods.
2.	Understand the role and significance of intrinsic and extrinsic factors on growth and response of microorganisms in foods.
3.	Describe the beneficial role of microorganisms in fermented foods and in food processing.
4.	Utilize laboratory techniques to detect, quantify, and identify microorganisms in foods.
5.	Acquire, discover, and apply the theories and principles of food microbiology in practical, real-world situations and problems.

Course Outcomes

After the completion of this course, students will be:

CO1	Understand the principles of microorganisms during various food-processing and preservation steps.
CO2	Isolation, identification, and enumeration of the most common microorganisms found in specific food products
CO3	Recognize specific types of microbial spoilage during various food shelf life stages.
CO4	Analyze different foods for presence of hazardous microorganisms using traditional and modern food microbiology technology
CO5	Describe the situations where improper food handling and storage may lead to the spoilage or contamination of food.

List of experiments

1. Food Microbiology Laboratory Safety and Notebook Record
2. Staining Technology and Bright-Field Microscope Use

3. Enumeration of Bacteria in Broth Suspension by Spread and Pour Plating
4. Isolation of Foodborne Pathogens on Selective, Differential, and Enriched Medium by Streak Plating
5. Enumeration of Aerobic Plate Counts, Coliforms, and Escherichia coli of Organic Fruit Juice on Petrifilm
6. Enumeration and Identification of Staphylococcus aureus in Chicken Salads
7. Enumeration and Identification of Listeria monocytogenes on Ready-to-Eat (RTE) food
8. Isolation and Identification of Salmonella and Campylobacter spp. on Broiler Carcasses
9. Isolation and Identification of Salmonella and Campylobacter spp. on Broiler Carcasses
10. Cultivation of Anaerobic Bacteria in Canned Food
11. Observation and Enumeration of Molds from Spoiled Bread
12. Environmental Influences and Control of Microbial Growth

Temperature: Effects on Growth and Lethal Effects
pH and Microbial Growth
Osmotic Pressure and Bacterial Growth
Oligodynamic Action

13. Ultraviolet Light Lethal Effects
14. Evaluation of Disinfectants and antimicrobial action

The Use-Dilution Method
Alcohol Its Effectiveness as a Skin Degerming Agent
Evaluation of Antiseptics:The Filter Paper Disk Method

15. Antimicrobic Sensitivity Testing: The Kirby-Bauer Method

Text Book:

1. S. Ranganna, Hand Book of Analysis and Quality Control forFruits and Vegetable Products, Tata McGraw Hill, 2002
2. John Wiley Frobischer M. 1968. *Fundamentals of Microbiology*.
3. Hans G. 1986. *General Microbiology*. Cambridge Univ. Press.

Reference Book:

1. Winton AL (1999)Techniques of food analysis, Allied Science Publications New Delhi.
2. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
3. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	3	3	3	1	2	3	3	1	3	3	3
CO2	3	2	2	3	3	3	3	1	2	3	3	1	3	3	3
CO3	3	2	2	3	3	3	3	1	2	3	3	1	3	3	3
CO4	3	2	2	3	3	3	3	1	2	3	3	1	3	3	3
CO5	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8

CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 209**
Course title: **Food Analysis**
Pre-requisite(s): **FT 201Food Chemistry&FT203 Food Microbiology**
Co- requisite(s): **FT Food Analysis Lab I**
Credits: 4 **L:04 T:00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IV/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To build knowledge of prepare samples of various foods products prior to analysis.
2.	To identify the various principles used to determine moisture, carbohydrate, lipid, proteins, ash, mineral, and vitamin content of a food
3.	To develop knowledge on the different modern analytical techniques and associated instruments required for the test.
	To familiarize with the conventional analysis of raw and processed food products of allcommodity technologies used for routine quality control in food industry, and their role onnutritional labelling

Course Outcomes

After the completion of this course, students will be:

CO1	Able to explain the reasons for determining composition and characteristics of food
CO2	Able to evaluate the role of food analysis in food standards and regulations for the manufacture and sale of food products
CO3	Able to develop oral and written communication skills to effectively communicate scientific ideas related with food analysis
CO4	To build an ability to assess the most appropriate analytical procedure required for a particular food analysis problem
CO5	To perceive knowledge on the different modern analytical techniques and associated instruments required for the test.

SYLLABUS

FT 209 Food Analysis

Module I: (Lectures 9)
Evaluation of analytical data accuracy, precision, source of errors, specificity, sensitivity. Sampling techniques; Sampling and sample preparation, Statistics and statistical terms in Food Analysis, Water activity, its measurements and significance in food quality; Calibration and standardization of different instruments. Basic principles of Classical Methods of food analysis. Law of mass action, Le chateliers principle, stoichiometry, volumetric and gravimetric analysis. Preparation of standards.

Module II: (Lectures 10)
Classical analytical techniques: Gravimetry, Titrimetry, Refractometry and Polarimetry: Principle, Instrumentation and applications of each technique in food analysis Spectroscopic techniques using UV/Vis, fluorescence, Raman spectroscopy, IR, FTIR, NIR, NMR, atomic absorption, ICP, polarimetry, refractometry, microscopic techniques in food analysis (light microscopy, SEM, TEM, XRD, particle size analysis, image analysis etc.).

Module III: (Lectures 10)
Chromatographic techniques: Adsorption, column, partition, affinity, ion exchange, size exclusion, GC, GLC, HPLC, HPTLC, GCMS, LCMS.

Module IV: (Lectures 10)
Separation techniques: Gel filtration, dialysis, electrophoresis, sedimentation, ultrafiltration and ultracentrifugation, solid phase extraction, supercritical fluid extraction, isoelectric focusing, isotopic techniques, manometric techniques. Measurements of Rheological properties: Instrumental Measurement of Texture of Foods, Visco Analysis, viscometer, texture analyseretc

Module V: (Lectures 10)
Biological Techniques (DNA/protein based): Fundamental principles and instrumentation of the systems; measurement techniques and result interpretations of Polymerase Chain Reaction (PCR), Real-time Polymerase Chain Reaction (PCR) technique; Enzyme Linked Immunosorbent Assay (ELISA); Radioimmunoassay (RIA). Use of PCR for detection of genetically-modified organisms (GMO);meat and fish speciation and other applications in analysis of food adulteration, Thermal methods in food analysis (Differential scanning colorimetry, TGA, Analysis of Vitamins, Enzymes, Pigments, Flavours, Pesticides). FSSAI standards and manuals for food Analysis

Text books:

1. AOAC International. 2003. Official methods of analysis of AOAC International. 17th Ed, Gaithersburg, MD, USA, Association of Analytical Communities.
2. Nielsen S. (Eds.). 1994. Introduction to Chemical Analysis of Foods. Jones & Bartlett.
3. Ranganna S. 2001. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. 2nd Ed. Tata-McGraw-Hill.

Reference books:

1. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
2 Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York

Gaps in the syllabus (to meet Industry/Profession requirements)

FSSAI standards of different food products

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Scientific basis behind the different Kits used for food Analysis

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	3	3	2	3	1	2	1	3	3	3	3	3
CO 2	3	3	3	3	3	2	3	1	2	1	3	3	3	3	3
CO 3	3	2	3	3	3	1	3	1	2	1	3	3	3	3	3
CO 4	3	2	3	3	3	1	3	1	2	1	3	3	3	3	3

CO 5	3	2	3	3	3	2	3	1	2	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 210**
Course title: **Food Biochemistry and Human nutrition**
Pre-requisite(s): **FT201 Food Chemistry**
Co- requisite(s):
Credits: **4** **L:04 T:00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IV/02**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To develop knowledge in diffrent aspects of nutrition and the functions of food
2.	To analyzethe relationship between food and the nutrients as well as function and contribution of nutrients to health of individuals
3.	To develop the knowledge on physiological and metabolic functions of nutrients
4.	To discover the methods of nutritional assessment, RDA and Dietary Recommendations & Guidelines.
5.	To interpret the food classification, nutrition during special conditions and role of special functional food

Course Outcomes

After the completion of this course, students will be:

CO1	Able to judge physiological and metabolic functions of nutrients
CO2	Able to evaluate with nutritional assessment, RDA and Dietary Recommendations & Guidelines.
CO3	Able to develop effective understanding of diet planning principles, exchange lists, food labels andnutrition facts for balanced nutrition and healthy diets.
CO4	Able to combine and use effectively, diet planning principles, exchange lists, food labels and nutrition facts for balanced nutrition and healthy diets.
CO5	Able to analyze functions of specific nutrients in maintaining health, identifying nutrient specific foods and apply principles from the various facets of food science and related disciplines to solve practical as well as real-world problems

SYLLABUS
FT 210 Food Biochemistry and Human nutrition

Module I: (9L)
Definition, six classes of nutrients, energy values calculationfrom food; RDA, nutritional status, nutritional requirement, malnutrition, nutritional assessment of individuals and populations, dietary recommendations; research methods in nutrition; Balanced diet; Healthy Diet: Diet planning principles, dietary guidelines; diet planning guides such as food groups, exchange lists, personal diet analysis; Food labels: serving sizes, nutrition facts, daily values, descriptive terms, health claims; Digestion, Absorption and Transport: Anatomy and physiology of the digestive tract, mechanical and chemical digestion, absorption of nutrients.

Module II: (9L)
Digestion and absorption of carbohydrates, lactose intolerance; Glycemic and Non-glycemic carbohydrates, blood glucose regulation, recommendations of sugar intake for health, health effects of fiber and starch intake, artificial sweeteners; Nutrition and Diabetes: Complications of diabetes mellitus, importance of blood sugar regulation, dietary recommendations for NIDDM and IDDM; Prebiotics.

Module III: (9L)
Food Sources, Lipid digestion, absorption and transport; Functions of the triglycerides; essential fatty acids- n-3 and n-6 fatty acids; trans fatty acids, Medium Chain Triglycerides, phospholipids and sterols; Health effects and recommended intakes of lipids. Digestion and absorption of proteins; Functions of proteins; amino acids; Protein quality, methods of assessing protein quality; Recommended intakes of proteins; protein and amino acid supplements; Protein Energy Malnutrition, Marasmus and Kwashiorkor; Chronic Energy; Deficiency- short term and long term effects.

Module IV: (9L)
Review of catabolic and anabolic pathways of glucose, fats and amino acids; Definition, units, calorific value of foods – bomb calorimeter; energy requirements – basal metabolism, specific dynamic action of foods, energy balance, direct and indirect calorimetry, physiological energy value of foods; Energy Balance and Body Composition: Energy balance; body weight and body composition; health implications; obesity, BMR and BMI calculations; Weight Control: Fat cell development; hunger, satiety and satiation; dangers of weight loss; how to identify unsafe weight loss schemes; treatment of obesity; attitudes and behaviors toward weight control.

Module V: (9L)
Water Soluble Vitamins: B vitamins (Thiamine, Riboflavin, Niacin, Pyridoxine, Biotin, folate B12, choline, pantothenic acid, and carnitine) and in concert, deficiencies, toxicities, and food sources; vitamin C roles and recommended intake, deficiency, toxicity and food sources. Fat Soluble Vitamins: A, D, E, and K: Function, recommended intakes, toxicities, Food sources; Water and Major Minerals: Water balance and recommended intakes; fluid/electrolyte balance, acid-base balance; function, recommended intakes, and regulation of sodium, potassium, and calcium. Trace Minerals: Food sources, function, recommended intakes, toxicities, deficiencies and transport of iron and zinc; importance of selenium, copper, fluoride, and chromium. co-

factors, anti-nutrients, nutraceuticals, Beneficiary microbes and there metabolism for improving health

Text books:

1. Essentials of Human Nutrition by Mann, Jim and Stewart Truswell "3rd Edition. Oxford University Press, 2007.**(T1)**

2. Introduction to Human Nutrition by Gibney, Michael J., et al2nd Edition. Blackwell,2009.**(T2)**

3. Advanced Nutrition and Human Metabolism, Gropper, Sareen S. and Jack L.Smith 5th Edition. Wadsworth Publishing, 2008.**(T3)**

Reference books:

1. Food Scienceby Charley, H, "John Wiley and Sons Inc., New York 1982.**(R1)**

2. The Sensory Properties ofFoods by Birch, G.G., Brennan, J. G. and Parker, K. J, "Applied Science Publication, London 1977. **(R2)**

3. Food – Biochemistry and Nutritional Value by Robinson, D. S, Longman Scientific and Technical, London 1987. **(R3)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Industrial important food hydrocolloid

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Food hydrocolloid its role in human nutrition

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)	Program Specific Outcomes (PSOs)

	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2	1	3	3	1	3	1	3	2	3	1	3	3	3
CO 2	2	2	1	3	1	1	3	1	2	1	3	2	3	3	3
CO 3	2	2	1	3	2	1	3	1	3	1	3	1	3	3	3
CO 4	2	2	1	3	2	1	3	1	3	1	3	1	3	3	3
CO 5	2	2	1	3	3	1	3	1	3	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT-211**
Course title: **Fruits and Vegetable Processing Technology**
Pre-requisite(s): **FT 204 Basics of Food Processing & Preservation**
Co- requisite(s): **FT 213 Fruits and Vegetable Processing Laboratory**
Credits: 4 L:04 T:00 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IV/2**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To develop the knowledge of students in the area of vegetable and fruit processing and technology
2.	To interpret the specific processing technologies used for vegetables and fruits and the various products derived from these materials
3.	To apply the application of scientific principles in the processing technologies specific to the materials
4.	To interpretate the alteration of composition after processing
5.	To propose the processing methods depending upon the raw material.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to develop thorough knowledge of the specific processing technologies used for vegetables and fruits and the various products derived from these materials.
CO2	Able to adapt better understand of the application of scientific principles in the processing technologies specific to the materials
CO3	Able to understand the changes in the composition of foods with respect to the type of processing technology used.
CO4	To propose the application of scientific principles in the processing technologies specific to the materials
CO5	To explain the changes in the composition of foods with respect to the type of processing technology used.

SYLLABUS
FT-211Fruits and Vegetable Processing Technology

Module I: (9L)
Difference in between fruits and vegetable; availability of Fruits and vegetables in India, season of maturity; Climatic and non climatic fruits, ripening process, phytonutrients in fruits and vegetables; General properties of fruit and vegetables; chemical composition and nutritional aspects; structural features.Importance of fruits & vegetables in the diet.

Module II: (9L)
Fruits and vegetables as living products, Deterioration factors and their control- enzymic changes, chemical changes, physical changes, biological changes during ripening process; Methods of reducing deterioration (Physical, chemical, biological and combined technique), Post harvest handling and storage of fresh fruits and vegetables-handling, grading, cleaning, pre-treatments, modified and controlled atmosphere packaging, chilling, transportation.

Module III (9L)
Fruits and vegetable preservation by low temperature; General pre-processing, Types of cold preservation; Types of freezers and freeze concentrators, processes and impacts of cooling methods below and above freezing point. Processing methods of frozen fruits and vegetables, different freezing methods and equipments, problems associated with specific fruits and vegetables IQF products, packaging, storage and thawing.

Module IV (9L)
Fruits and vegetable preservation by high temperature: extraction, clarification, concentration and packaging of fruit juice; Thermal processing and process time evaluation for canned products, process optimization, aseptic canning, methods for canning of different fruits, and vegetables; Dehydration and associated quality changes during drying and storage of dehydrated products. Methods of drying including sun, tray, spray drying and low temperature, osmotic dehydration and other modern methods. Application of membrane technology in fruits juice processing.

Module V (9L)
Jam, jelly, marmalade, squash, candies, tomato sauce, ketchup, puree, paste and sauce, potato chips; Chemistry and manufacture of pectin, role in gel formation and products like jellies and marmalades. Technology of pickles, chutney's and soup, nature and control of spoilage. Preparation and utilization of fruits and vegetables juices in non-fermented/ fermented/ aerated beverages, health drinks. Utilization of by-products of fruits and vegetable Industry. Fermented fruits and vegetable product (wine, pickles, soya-sauce, sauerkraut etc.)

Text books:

1. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
2. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

1. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
2. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

CIP in fruits and vegetable processing

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Sanitization in during fruits and vegetable processing

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	3	3	2	3	1	1	1	3	3	3	3	3
CO 2	3	2	2	3	2	2	3	1	1	1	3	3	3	3	3
CO 3	3	2	2	3	2	2	3	1	1	1	3	2	3	3	3
CO 4	3	2	2	3	2	2	3	1	1	1	3	2	3	3	3
CO 5	3	2	2	3	2	2	3	2	1	1	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 212**
Course title: **Fluid Mechanics and Mechanical Operations**
Pre-requisite(s): **FT 202 Introduction to Food Engineering**
Co- requisite(s): **-**
Credits: **L:03 T:01 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IV/02**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	To understand the principles and applications of fluid mechanics
2.	To review the practical importance and relevance of unit operations used for crushing, grinding and size separation in Food industry.
3.	To understand basic principles of various mechanical operations, construction and working of the equipments
4	To develop the concepts of size reduction, conveying and mixing criteria of food material
5	To develop ability to select suitable size reduction equipment, solid-solid separation method and conveying system

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to make use of knowledge of basic principles of fluid mechanics
CO 2	Able to apply the knowledge of fluid mechanics in various fluid flow problems
CO 3	Able to explain solid–fluid separation techniques
CO4	Able to explain process of food materials handling, size reduction and transportation.
CO 5	Able to explain mixing and extrusion processes involved in food processing

SYLLABUS

FT 212 Fluid Mechanics and Mechanical Operations

Module I:(9L)
Fluid Properties -viscosity, Newton's law of viscosity, Continuity equation, Reynolds number, Laminar and turbulent flow, Entrance region and fully developed flow, flow through circular pipe, Friction factor, Bernoulli equation, frictional energy loss, Flow characteristics of Non-Newtonian Fluids. Viscosity measurement : Capillary tube viscometer, Rotational viscometer.

Module II:(9L)
Pump theory, Centrifugal and Positive displacement pumps, pump selection & performance evaluation. Flow measurements: Manometers, Pitot tube, orifice meter, venturi meter, Rotameter etc. Agitated and missing of liquids: Types of impellor, Power Requirement

Module III:(9L)
Flow past immersed objects, Motion of particles through fluids, Stokes law, Fluidization, Gravity decanter, Gravity and Centrifugal settling, Separation and concentration of food components: Filtration, Expression, Membrane concentration (microfiltration and ultrafiltration).

Module IV: (9L)
Raw material preparation: Cleaning, Sorting, Grading, Peeling; Particle size analysis; Size Reduction of solid foods: Theory, equipment, Effect on foods; Size reduction in liquid foods (emulsification and homogenisation): Theory, equipment, effect on foods. Materials storage and handling equipment for raw materials, ingredients and processing- Silos, belt, screw, vibrated conveyors etc. Elevator and hoists, fork lifts, Pneumatic and water flume transportation etc

Module V:(9L)
Mixing: Theory of mixing of solids and pastes, Mixing Index, Mixing equipment – masticator, kneader etc., effect on foods;
Basic Principles of Extrusion, Extrusion Systems- Cold extrusion, extrusion cooking, single screw extruders, twin-screw extruders, extrusion system design.

Text books:

1. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T1)**
2. Elements of Food Engineering by R.T. Toledo, (T2)
3. Food Process Engineering and Technology, Zeki Berk), Academic Press.(T3)
4. Food Processing Technology, Principles and Practice, P. Fellows, CRC Press.(T4)

Reference:

1. Unit Operations In Food Engineering by Albert Ibarz and Gustavo V. Barbosa-Cánovas, CRC Press, 2003. **(R1)**
2. Unit Operations in Food Processing by R. L. Earle, 2nd Edition, Pergamon Press,Oxford,U.K, 2003. **(R2)**

3. Physical Properties of Foods &Foods Processing Systems by M. J. Lewis, EllisHorwood, England, 1987. **(R3)**
4. Unit Operations of Chemical Engg*by* McCabe and Smith **(R4)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Fluid flow and mechanical operations machineries used in food sector

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Fluid flow and mechanical operations machineries used in food sector

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2	3	2	2	3	1	1	1	3	3	3	3	3
CO 2	2	3	2	3	2	2	3	1	1	1	3	3	3	3	3
CO 3	2	3	2	3	2	2	3	1	1	1	3	3	3	3	3
CO 4	3	2	2	3	2	1	3	1	1	1	3	3	3	3	3
CO 5	2	3	2	3	2	2	3	1	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 213**
Course title: **Fruits and Vegetables Laboratory**
Pre-requisite:
Co- requisite(s): **FT211 Fruits and Vegetable Processing Technology**
Credits: 2 **L:0 T:00 P:04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IV/02**
Branch: **Food Technology**

Course Objectives
This course enables the students:

1.	To train the students in the field of Fruit and Vegetable Processing
2.	.To make aware a student with knowledge of the basic post harvest biological, chemical, physiological and metabolic processes and changes in fruits and vegetables
3.	To enable the students learn different preservation techniques to curb post-harvest losses in the field of agriculture.
4.	To explain processing technology of jam, jelly and marmalades
5.	To perform the quality analysis of of jam, jelly and marmalades

Course Outcomes

After the completion of this course, students will be:

CO1	Establish the quality specifications for the processing of fruit and vegetables.
CO2	Apprehend different operations like cleaning, grading, peeling concentration and different aroma recovery systems etc involved in the fruits and vegetables processing
CO3	Grasp the concept of quality in relation to fruit and vegetable based products.
CO4	Understand the processing and preservation techniques for fruits and vegetables to improve the shelf life.
CO5	Understand the physiological changes occurring to fruit and vegetables during harvesting and storage

List of experiments:

1. Introduction to fruits and vegetable processing

A: Study on Role of FSSAI

B: Food processing facilities in the Laboratory

C: Determination Benzoic acid

2. Preparation of (A) Sauerkraut (B) Pickled cucumber by (i) Brine process (ii) Fresh pack Process

3. Preparation and quality control of fruit (a)jelly& (b)marmalade

4. Studies on pre-treatment of fresh cut and vegetable

5. Preparation of fruit juice beverage

6. Preparation and quality control of Tomato ketchup

7. Preparation of nectar (Mango / guava/ Peach)

8. Preparation of Fruit bar (Mango)

9. Preparation of Tropical fruit jam (Pineapple, Guava, Papaya etc.)

10. Preparation of Orange marmalade

11. Preparation of Fruit in syrup (Pineapple/Peaches/ Guava halves and slices)

12. Preparation of Pickled chili peppers

13. Preparation of Tomato juice

14. Preparation of Tomato Juice/puree/ simple concentrate

15. Preparation of Dried tomatoes, Whole peeled tomatoes,/ bananas

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland

2.AOAC methods for Food Analysis.

3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.

4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York

5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995

3. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

3. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable

4. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	1	2	3	1	1	1	3	2	3	3	3
CO2	3	2	2	3	2	2	3	1	1	1	2	1	3	3	3
CO3	3	2	2	3	1	3	3	1	1	1	3	2	3	3	3
CO4	3	2	2	3	3	3	3	1	1	1	3	3	3	3	3
CO5	3	2	2	3	2	3	3	1	1	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD	CO1	CD4, CD5, CD7, CD8

	projectors/OHP projectors		
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 214**
Course title: **Food Analysis Laboratory I**
Pre-requisite:
Co- requisite(s): **FT 209 Food Analysis**
Credits: 2 **L:00 T:00 P:04**
Class schedule per week: **04**
Class: **IMSc**

Semester / Level: **IV/02**
Branch: **Food Technology**

Course Objectives:
This course enables the students will be able to :

1.	Be familiar with the current state of knowledge on food composition
2.	Understand the principles behind analytical techniques associated with food
3.	Know methods of selecting appropriate analytical techniques when presented with a practical problem
4.	Demonstrate practical proficiency and teamwork in a food analysis laboratory
5.	Use library and internet resources pertaining to food analysis

Course Outcomes

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

CO1	Get acquainted with analytical methods used for quality control analysis of raw material and processed food commodities.
CO2	Conduct appropriate laboratory experiments common to basic and applied food analysis and interpret the results.
CO3	Work cooperatively in a team to identify a food Analysis problem, design and conduct the experiments, and analyze and interpret the data.
CO4	Clearly communicate research results using appropriate written, oral, and visual communication techniques.
CO5	Demonstrate practical proficiency in a food analysis laboratory

List of Experiments

1. Sampling and sample preparation of food samples
2. Gravimetry, Titrimetry, Refractometry and Polarimetry applications in Food
3. Determination of Calorific value of food
4. Determination of moisture by using conventional oven, Vacuum oven, IR moisture balance
5. Determination of Nitrogen content in food by Kjeldahl method
6. Determination of fat content by Solvent extraction
7. Determination of Ash and Crude Fibre
8. Determination of dietary Fibre.
9. Determination of unknown concentration by UV-Visible spectroscopy
10. Determination of Chemical Oxygen Demand of waste water
11. Determination of Biological Oxygen Demand of waste water
12. HPLC analysis of food sample

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
4. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

5. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
6. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	2	3	3	1	2	1	3	3	3	3	3
CO2	3	2	2	3	2	3	3	1	2	1	3	3	3	3	3
CO3	3	2	2	3	2	3	3	1	2	2	3	3	3	3	3
CO4	3	2	2	3	2	3	3	1	2	1	3	3	3	3	3
CO5	3	2	2	3	2	3	3	1	2	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8

CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 301**
Course title: **Cereals Pulses & Oilseed Technology**
Pre-requisite(s): **FT 204 Basics of Food Processing & Preservation**
Co- requisite(s): -
Credits: 4 L:04 T:00 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **V/03**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand the basic composition and structural parts of food grains.
2.	To interpret the importance of cereals as foods, and appreciate their nutritional value
3.	To developthe basic knowledge and principles of cereal science, the production processes and technologies for cereal products, and the quality, sanitary control and assurance for cereal processing.
4.	To list the various components of cereals and their approximate levels, their functional roles in the various cereal foods, and methods of analysis
5.	To utilize the application of scientific principles in the processing of cereal and cereal based product.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to identify the importance of cereals as foods, and understand their nutritional value.
CO 2	Able to discover the proper methods of wheat and grain handling and storage
CO 3	Able to categorize the botanical, physical, and chemical criteria of wheat quality, their methods of evaluation, roles in wheat grading and processing.
CO 4	Able to explain the dry milling processes of bread and durum types of wheat, and how flour grades are obtained.
CO 5	Able to describe how bread, biscuits, pasta, and breakfast cereals are produced, and identify the parameters involved in their quality evaluation

Syllabus

FT 301Cereals Pulses & Oilseeds Technology

Module I (9L)

Status, major growing areas and production of cereals and millets in India and in the world; Structure and composition of different grains (wheat, rice, barley, oat, maize and millets); Anti-nutritional factors in grains and oilseeds; Milling, storage and insect control; Wheat– classification, grain quality and milling, Atta and maida, quality aspects of flour, wheat proteins and their function, rheology; Wheat flour/semolina and its use in traditional/non-traditional foods like breads, biscuits, cakes, doughnuts, buns, pasta goods, extruded, confectionary products, breakfast and snack foods;Preparation of vital wheat gluten and its utilization; Instant ready mixtures; Enzymes (amylases and proteases) in milling and baking.

Module II (9L)

Varieties of rice grown in India and other countries; Storage, Insect control; Processing: Rice - Milling, and sorting; Parboiling, Polishing; Quick cooking rice, factors affecting quality of rice,Traditional Indian Products- Puffed Rice, flaked rice, Rheology rice flour; By-products of rice milling and their utilization; Processed products from rice; Bran, germ and novel products from wheat / rice.

Module III (9L)

Barley: Pearling, malting, brewing and preparation of malted milk feeds from barley. Significance of β- glucans. Corn - Wet and dry milling, Corn Products – Corn flakes, , corn syrup (HFCS); Corn starch, canned corn products, corn steep liquor and germ oil, puffed product; Oats- Milling, Oat Products – Steel cut, rolled oats, quick cooking; Processing into oat flakes, porridge and oatmeal; Rye bread-Traditional cereal products; Sorghum, Pearl Millet, Finger millet, Foxtail millet, Kodo Millet - storage, insect control;processing - Pearling, Milling, Malting, Malt based foods, flaked and fermented products;Traditional and Nutritional products based on finger millet.

Module IV (9L)

Pulses: Structure and composition of pulses and their importance in Indian diet; Cleaning, grading, pretreatments for difficult-to-mill (urad, arhar, moong, moth) and easy-to-mill (chana, masoor and pea) legumes, milling practices and actual milling of different legumes. Use in traditional products, protein concentrates and isolates. Oilseeds: edible oilseeds, composition and importance in India; Oilseed processing; Oil extraction and its processing, byproducts of oil refining. Production, packaging and storage of vanaspati, peanut butter, protein concentrates, isolates and their use in high protein foods. Export of oilseed cakes. International market and consumer preferences for quality in cakes for use in textured vegetable proteins; Modified starches and proteins. Processing and utilization of soya bean for value added products.

Module V (9L)

Dairy analogues based on plant milk. Spices Processing: Oleoresin and essential oil extraction; Baked foods - chemical dough development, mechanical dough development, sheeting extrusion other rapid methods; Bread staling – theory, manifestation, retardation measures; Indian

Confectionery. Extrusion processes for foods- principles of extrusion, Extrusion systems – cold extrusion, extrusion cooking, single and twin screw extruders. Technology of Macaroni and pasta products, extrusion cooking. Fermented cereal and pulse based product (Beer, rice beer, Papads, wari, Idli, Dosa, Dhokla, soy sauce etc.) ; Idli/Dosa/vada mixes and other instant products.

Text books:

1. Post Harvest Technology Of Cereals,pulses And Oilseedsby Chakraverty A.3rd Ed.2008**(T1)**
2. The Chemistry and Technology of Cereals as Food and Feedby Matz, Samuel A. 2nd Edition, CBS, 1996.**(T2)**
3. Principles of Cereal Science and TechnologyBy Delcour, Jan A. and R. Carl Hoseney. 3rd Edition. American Association of Cereal Chemists, 2010.**(T3)**
4. Handbook of Cereal Science and Technologyby Kulp, Karel. 2nd Edition,CRC Press, 2000.**(T4)**
5. Cereal Biotechnologyby Morris, Peter C. and James H Bryce CRC / Woodhead, 2000**(T5)**

Reference books:

1. Technology of Cereals by N.L.Kent. pergaman Press,1966**(R1)**
2. Food Facts and Principles by Mannay;New age International (P) Ltd.**(R2)**
3. Food Science by Norman N.Potter;CBS Publications.**(R3)**
4. Development in Milling & Baking Technology by AFST (I), CFDRI, Mysore, India.**(R4)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Recent Industrial developments in Cereal and pulse fortification

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Cereal and pulse fortification

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5

End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	3	2	2	1	3	1	2	1	3	3	3	3	3
CO 2	3	3	3	2	2	1	3	1	2	1	3	3	3	3	3
CO 3	3	3	3	2	2	1	3	1	2	1	3	3	3	3	3
CO 4	3	3	3	2	2	1	3	1	2	1	3	3	3	3	3
CO 5	3	3	3	2	3	2	3	1	2	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 302**
Course title: **Heat Transfer in Food Processing**
Pre-requisite(s): **FT 202 Introduction to Food Engineering**
Co- requisite(s):
Credits: **L:03 T:0 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **V/3**
Branch: **Food Technology**
Name of Teacher:

Course Objective

1	To understand the basic laws of heat transfer
2	To interpret and apply the principles in heat transfer.
3	To apply the knowledge of heat transfer in design calculation of heat transfer equipment.
4	To account for the consequence of heat transfer in thermal analyses of engineering systems.
5	To analyze problems involving steady state heat conduction in simple geometries.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to apply the knowledge of conduction heat transfer in steady and unsteady state
CO2	Able to explain the concepts of heat transfer by convection and radiation
CO3	Able to solve the design problems for various types of heat exchanger
CO4	Able to understand and apply concepts of heating process using radiation
CO5	Able to apply the basic concepts of evaporation, condensation, steam generation.

Syllabus
FT FT 302 Heat Transfer in Food Processing

Module I: (9L)
Introductory concepts, modes of heat transfer, thermal conductivity of materials. General differential equation of conduction, One dimensional steady state conduction through plane and composite walls, tubes and spheres without heat generation; Insulation materials, critical thickness of pipe insulation; Transient heat conduction, lumped capacity, Biot number, Fourier number; use of charts to determine time required for heating/cooling of solid food.

Module II: (9L)
Free and forced convection. Dimensional analysis of free and forced convection; Useful non-dimensional numbers and empirical relationships for free and forced convection; laminar boundary layer on flat plate and in a tube. Radiation: Absorptivity, reflectivity and transmissivity of radiation; Black body and monochromatic radiation, Planck's law, Stefan-Boltzmann law, Kirchoff's law, grey bodies and emissive power, solid angle, intensity of radiation; Radiation exchange between black surfaces, geometric configuration factor.

Module III: (9L)
Introduction to heat exchangers, types of heat exchangers in food processing industries – Double pipe, Triple pipe, Steam infusion, Plate, shell and tube Heat Exchange, estimation of overall heat transfer coefficient, fouling of heat transfer surfaces, Cocurrent and Counter current flow, Log mean temperature difference, Design of a tubular heat exchanger, the effectiveness-NTU method for designing heat exchangers, Design of a plate heat exchanger.

Module IV: (9L)
Unsteady state heat transfer in batch vessels– heating and cooling; Microwave, Radio frequency, Ohmic, and Infrared heating: Theory, Equipment, Applications, Effect on foods;Freezing: Theory, Time of Freezing, Plank's Equation, Renewable energy for food processing - solar energy, wind energy.

Module V: (9L)
Heat transfer to fluid with phase change: Film condensation and drop condensation, Heat transfer to boiling liquids, pool boiling, forced convection boiling. Evaporation: Boiling-Point elevation, Types of evaporators: Batch type pan evaporator, natural circulation evaporators, Rising film evaporator, Falling-film evaporator, Forced circulation evaporator, Agitated thin-film evaporator; Design of a single-effect and multiple effect evaporator, Steam generation systems, steam table, steam utilization, fuel utilization, Furnace and hot air oven.

Text books:

1. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T1)**
2. Elements of Food Engineering by R.T. Toledo, **(T2)**
3. Food Process Engineering and Technology, **Zeki Berk), Academic Press.(T3)**

4. FOOD PROCESSING TECHNOLOGY, Principles and Practice, P. Fellows, CRC Press.(T4)

Reference:

1. Unit Operations In Food Engineering by Albert Ibarz and Gustavo V. Barbosa-Cánovas, CRC Press, 2003. **(R1)**
2. Unit Operations in Food Processing by R. L. Earle, 2nd Edition, Pergamon Press,Oxford,U.K, 2003. **(R2)**
3. Physical Properties of Foods &Foods Processing Systems by M. J. Lewis, EllisHorwood, England, 1987. **(R3)**
4. Unit Operations of Chemical Engg*by* McCabe and Smith **(R4)**
5. Unit operations in Agril processing *by* Sahay and Singh **(R5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Software applications for determining heat transfer profile in food equipments

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Software applications for determining heat transfer profile in food equipments

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	3	3	1	3	1	1	1	3	3	3	3	3
CO 2	3	2	3	3	3	1	3	1	1	1	3	3	3	3	3
CO 3	3	2	3	3	3	1	3	1	1	2	3	3	3	3	3

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

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: FT 303
Course title: Meat, Fish and Poultry Product Technology
Pre-requisite(s): FT204 Basics of Food Processing & Preservation
Co- requisite(s):
Credits: 4 L:04 T:00 P:00
Class schedule per week: 04
Class: IMSc
Semester / Level: V/03
Branch: Food Technology
Name of Teacher:

Course Objectives

This course enables the students:

1.	To define the composition and structure of various meat, poultry, and seafood.
2.	To interpret and choose the specific processing technologies used for meat, fish & poultry
3.	To apply the scientific principles in the processing technologies specific to meat, fish & poultry relating to value addition and extension of shelf life
4.	To explain the specific processing technologies used for meat, fish & poultry and the various products derived from these materials

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to develop better understanding on composition and structure of Meat, Fish & Poultry products
CO 2	Able to explain different muscle structure related to physical and chemical properties.
CO 3	Able to utilize different processing methods to preserve and value add such product.
CO 4	Able to choose different processing machineries for preservation and value addition
CO 5	Identify, explain and demonstrate effective sanitation techniques for ensuring consumer safety.

Syllabus
FT 303 Meat Fish and Poultry Product Technology

Module I (9L)
Scope of meat, fish and poultry processing in India;Process flow sheet of meat, fish and poultry processing; Sources of meat and meat products in India, its importance in national economy; Chemistry and microscopic structure of meat tissue; Methods of grading meat; Ante mortem inspection- effect feed, breed, stress, and management on meat production and quality. Methods of stunning, slaughter and dressing of various animals,Poultry handling and dressing: inspection of birds, poultry slaughter and dressing, factors affecting quality of poultry; Methods of scalding, defeathering, evisceration, inspection and grading; Mechanical deboning, meat tenderization and associated equipments.

Module II (9L)
Physical and chemical changes in meat; Post mortem examination; Factors affecting post-mortem changes, properties and shelf life of meat; Rigor mortis;Meat tenderization and role of enzymes in meat processing;Retails and wholesale cuts; Microbial factors influencing keeping quality of meat; Meat plant sanitation and safety, meat quality evaluation; Factors affecting meat quality; Packing of meat.

Module III (9L)
Basic preparatory procedures like comminution, emulsification; Meat preservation: smoking, canning, irradiation, dehydration and curing; Poultry and their products. Meat products- meat emulsion, sausages, communited meat products, ham, bacon. Zoovosic diseases., Meat plant sanitation and waste disposal. Meat plant sanitation and safety, Byproduct utilization; Recent trends in meat processing; MMPO, MFPO ; meat safety. Kosher and Halal certification, safety issues, regulation and quality assurance.

Module IV (9L)
Structure and composition of egg and factors effecting quality; Quality measurement, Preservation of eggs using oil coating, refrigeration, thermo stabilization and antibiotics; Packing, storage and transportation of eggs; Technology of egg products viz. egg powder, albumen, flakes and calcium tablets.Classification of fresh water fish and marine fish; Commercial handling, storage and transport of raw fish; Average composition of fish; Freshness criteria and quality assessment of fish; Spoilage of fish; Methods of Preservation of fish: Canning, Freezing, Drying, Salting, smoking, curing, fermentation (fish sauce).

Module V (9L)
Value added fish products-fermented fish, fish soups, fish powder, prawn powder and cutlets; Fish products - production of fish meal, fish protein concentrate, fish liver oil, fish silage and fish sauce and other important by-products; Production of chitin, chitosan; Production of non-food items from fish processing wastes. Quality control of processed fish; Fish processing industries in India, Processing of crab, prawns, seaweeds; Freezing techniques and irradiation process;

Seaweed products like pickles, hydrocolloids and oil.

Text books:

1. Essentials of food scienceby Vaclavik V.A. and Christian E.W. (2003). 2nd edition, Springer International. **(T1)**
2. Egg science and technologyby Stadelman W.J. and Cotterill O.J. (2001) CBS Publishers.**(T2)**
3. Fish Processing Technology , Rogestein&Rogestein**(T3)**
4. Egg Science & Technology; Stadelman WJ & Cotterill OJ; 1973, AVI Pub.**(T4)**
5. Food science by Potter**(T5)**

Reference books:

1. Improving the Sensory and Nutritional Quality of Fresh Meat byKerry, J.P. CRC/Wood Head, 2009**(R1)**
2. Seafood Processing: Adding Value through Quick Freezing, Retort able Packaging and Cook-Chilling & other methodsby Venugopal, V. (Food Science and Technology Vol. 13), CRC press, 2006**(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Sensor application in Meat Fish and Poultry Product

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Sensor application in Meat Fish and Poultry Product

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	2	3	2	1	3	1	2	1	3	3	3	3	3
CO 2	2	3	2	3	2	1	3	1	2	1	3	3	3	3	3
CO 3	3	3	2	3	2	1	3	1	2	2	3	3	3	3	3
CO 4	3	3	2	3	2	1	3	1	2	1	3	3	3	3	3
CO 5	3	3	2	3	3	1	3	1	2	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
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CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 304**
Course title: **Cereal Technology Laboratory**
Pre-requisite(s):
Co- requisite(s): **FT301 Cereals Pulses and Oilseeds Technology**
Credits: 2 **L:00 T:00 P:04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **V/03**
Branch: **Food Technology**
Name of Teacher:

This course enables the students will be able to:

1.	Understand of the uniqueness of wheat as a cereal grain in the world food supply and the scientific nature of the functionality and inter-relationships of the key constituents in wheat for food utilization.
2.	Interpret the importance of cereals as foods, and appreciate their nutritional value
3.	Develop the basic knowledge and principles of cereal science, the production processes and technologies for cereal products, and the quality, sanitary control and assurance for cereal processing.
4.	List the various components of cereals and their levels, their functional roles in the various cereal foods, and methods of analysis
5.	Utilize the application of scientific principles in the processing of cereal and cereal based product.

Course Outcomes

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

CO1	Describe the proper methods of wheat and grain quality analysis
CO2	Categorize the botanical, physical, and chemical criteria of wheat quality, their methods of evaluation, roles in wheat grading and processing.
CO3	Explain the dry milling processes of bread and durum types of wheat, and how flour grades are obtained.
CO4	Describe how bread, biscuits, pasta, and breakfast cereals are produced, and identify the parameters involved in their quality evaluation
CO5	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO6	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Physical Characterization of wheat
2. Determination of wet and dry gluten
3. Gluten content and protein quality of wheat flour
4. Studies on gliadin and glutenin in wheat flour
5. Physicochemical and cooking characteristics of rice :
6. Hulling recovery, (b) Milling recovery, (c) Head rice recovery Test weight, Kernel length, breadth, Length/breadth ratio and grain classification, seed grade, water uptake, volume expansion ratio, kernel elongation after cooking and kernel elongation ratio, Alkali spreading value/gelatinization temperature Gel consistency, Amylose content,
7. Determination of hectolitre weight
8. Determination of grain hardness
9. Determination of sedimentation value
10. Determination of β-carotene
11. Estimation of starch
12. Estimation of true and non-protein
13. Phenol test for cereals
14. Determination of tryptophan content in maize flour by papain hydrolysis
15. Determination of lysine content

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
5. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

7. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
8. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	2	3	3	3	1	1	1	3	3	3	3	3
CO2	3	2	2	3	3	3	3	1	1	1	3	3	3	3	3
CO3	3	2	2	2	3	3	3	1	1	1	3	3	3	3	3
CO4	3	2	3	3	3	3	3	1	2	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	1	2	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8

CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 305**
Course title: **Food Product Development Laboratory**
Pre-requisite(s):
Co- requisite(s):
Credits: 2 **L:00 T:00 P:04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **V/03**
Branch: **Food Technology**
Name of Teacher:

This course enables the students:

1.	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
2.	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
3.	Compare and contrast conventional and emerging food processing technologies in real-life food processing
4.	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Course Outcomes

After the completion of this course, students will be:

CO1	To describe Food Processing in terms of unit operations, both conceptually and in the pilot plant basis
CO2	To understand the use of mass and energy balances for food processing
CO3	To apply critical thinking skills to new food processing situations
CO4	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Development of fried snacks from cereals
2. Development of vegetables based snacks(RTE)
3. Preparation of food spreads as per FSSA standards
4. Preparation of ready to cook "kheer mix"
5. Role of salt in preservation of pickles
6. Extension of shelf life of fresh agro-produce by post-harvest treatment (application of wax and packaging)
7. Development of a prebiotic food product
8. Development of sundried products from cereal, legumes and vegetables
9. Preparation of green chilli sauce
10. Preparation of fruit juice concentrates
11. Development of spices powder and their quality analysis
12. Sensory tests of developed Prebiotic foods
13. Extraction of oils from red chilli using organic solvents
14. Production of food colours from natural resources
15. Extraction of orange flavour and oil from orange peel

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
6. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

9. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
10. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	2	3	3	3	3	1	1	1	3	3	3	3	3
CO2	3	3	2	3	3	3	3	1	1	1	3	3	3	3	3
CO3	3	2	3	3	3	3	3	1	2	2	3	2	3	3	3
CO4	3	3	3	3	3	3	3	1	2	2	3	3	3	3	3
CO5	3	3	3	3	3	3	3	1	2	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8

CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 306**
Course title: **Food Analysis Laboratory II**
Pre-requisite(s): **FT214 Food Analysis Laboratory I**
Co- requisite(s):
Credits: 2 **L:00 T:00 P:04**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **V/03**
Branch: **Food Technology**
Name of Teacher:

Course Objectives:
This course enables the students will:

1.	Be familiar with the current state of knowledge on food composition
2.	Understand the principles behind analytical techniques associated with food
3.	Know methods of selecting appropriate analytical techniques when presented with a practical problem
4.	Be able to demonstrate practical proficiency and teamwork in a food analysis laboratory
5.	Be able to use various instrument and protocols for food analysis

Course Outcomes

After the completion of this course, students will be:

CO1	Acquainted with analytical methods used for quality control analysis of raw material and processed food commodities.
CO2	Able to conduct appropriate laboratory experiments common to basic and applied food analysis and interpret the results.
CO3	Able to Work cooperatively in a team to identify a food Analysis problem, design and conduct the experiments, and analyze and interpret the data.
CO4	Able to clearly communicate research results and tell the quality of food products using appropriate techniques.
CO5	To apply critical thinking skills to new food processing situations

List of experiments

1. Determination of concentration of metal ion by colorimeter
2. Conductometric titration of acid/base, precipitation and metal ion complex
3. Acid base titrations by pH meter
4. Kinetic study of mutarotation of glucose by polarimeter
5. Determination of metal ion concentration by Atomic absorption spectroscopy
6. Microwave digestion of food sample and determination of metal ion concentration by ICP-OES
7. Texture Analysis of Food sample
8. Rheology of CMC solution by Brookfield viscometer
9. Differential Scanning Calorimetry
10. Thermogravimetric analysis
11. Ion Chromatography analysis of digested food sample

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
7. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

11. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
12. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	**1**	**2**	**3**
CO1	3	2	2	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	2	2	3	3	3	3	2	3	3	3	3	3	3	3
CO3	3	2	2	3	3	3	3	2	2	3	3	3	3	3	3
CO4	3	3	2	3	3	3	3	2	2	3	3	3	3	3	3
CO5	3	2	3	3	3	3	3	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8

CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 308**
Course title: **Dairy Technology**
Pre-requisite(s): **FT 212 Fluid Mechanics and Mechanical Operations, FT302 Heat Transfer in Food Processing FT203 Food Microbiology**

Co- requisite(s): **FT312 Dairy Technology Laboratory**
Credits: 4 **L:04 T:00 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VI/03**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	To develop understanding in milk chemistry and interpret the role of the various components of milk as functional components of different dairy products.
2.	To contrast knowledge on the specific processing technologies used for milk and the various products derived from milk and their quality attributes.
3.	To Make use of the understandings on physical, chemical, microbiological properties of milk and their interaction in food products in terms of color, flavor, texture and nutritional composition of milk.
4.	To interpret the significance and role of homogenization, pasteurization, sterilization and UHT in quality of milk and processed products.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to build knowledge in dairy chemistry and discover the role of the various components of milk as functional components of different dairy products.
CO 2	Able to adapt specific processing technologies used for milk and the various products derived from milk.
CO 3	Able to evaluate the quality attributes of dairy and dairy based product
CO 4	Able to apply starter culture technology and select starters for production of different dairy products.
CO 5	Able to develop competency in the students for adopting dairy processing and product manufacturing as an enterprise.

FT 308 Dairy Technology

Module I: (9L)

Present status of dairy processing in India and Abroad; Importance of milk processing in India: NDDB & Operation flood. Milk: Definition, types, composition, nutritive value; Physical properties and chemical composition of different milch animal (cow, buffalo and other species); Checks for quality of milk: different tests associated with purity, contaminations & adulterants: Dairy plant operations viz. receiving, separation, clarification, pasteurization, standardization, homogenization, sterilization, storage, transport and distribution of milk; Centrifugal separation, clarification and bactofugation and factors affecting their efficiency; Homogenization process and its implications in dairy processing; efficiency of homogenization and factors affecting it.

Module II: (9L)

Pasteurization (LTLT and HTST), sterilization, UHT processing and aseptic packaging; Special milks: Principles of production, processing and marketing of toned, double toned, reconstituted, recombined, flavoured and filled milks; Packaging of fluid milk; Different dairy plant equipments its handling and maintenance.Concentrated and Dried Milk Products: Principles and methods of manufacture, storage and defects in sweetened condensed milk; Evaporated milk, UHT sterilized concentrated milk; Whole milk powder, Skim milk powder, high-fat powders, and ice-cream powder. Instantization of milk powder. Newer technologies and formulations for infant foods and weaning foods, malted milk and malted milk foods.

Module III: (9L)

Fat rich dairy products:- principles and concepts in production and processing of different types of cream, butter, margarine, fat spreads, butter oil and ghee; fractionation of fat and its application, health aspects of milk fat, cholesterol reduced and cholesterol-free dairy products.Frozen Milk Products: Definition, classification and composition of ice-cream and other frozen desserts, role of milk constituents and other ingredients, processing steps, packaging and storage methods on quality of ice cream, Technological aspects of manufacture of plain, fruit, soft-serve, low fat and dietic ice-creams and novelties; Indigenous frozen desserts, kulfi, malai-ka-baraf etc.; their production techniques and quality, distribution of frozen desserts. Newer ingredients for use in the ice-cream industry.

Module IV: (9L)

Cheese and Fermented Milk Products: their nutritional and therapeutic value, definition and classification of cheese and fermented milks; Milk in relation to cheese making, Manufacture of Cheddar, Gouda, Mozzarella and Swiss cheeses,role of starter cultures, storage and defects. Types of rennet, Physical and chemical changes during cheese ripening, Manufacture of processed cheese, cheese spread and cheese foods; Mechanization of cheese-makingprocess, accelerated cheese ripening, Cheese spreads by spray and roller drying techniques. EMC (Enzyme modified cheese), Enzymes in dairy processing. Production and storage of dahi, yoghurt, shrikhand, lassi and mistidohi. Probiotic dairy products.

Module V: (9L)

Cleaning and sanitization of dairy plant: properties of important dairy detergents and sanitizers,choice of detergents and sanitizers, guiding principles and limiting factors, Basic principles in formulating the cleaning and sanitizing procedures for dairy equipments,automation in cleaning and sanitization processes including CIP, Quality of water in detergency, Dairy waste disposal;Safety aspects of milk with reference to mycotoxins, antibiotics, pesticides, weedicides and heavy metals; PFA, BIS and Agmark standards for milk and milk products; Quality systems such as HACCP, ISO certification, etc; Packaging application in dairy products.

Text books:

1. Smit, G. (2003) Dairy processing - improving quality. Woodhead Publishing.**(T1)**
2. Walstra P., Geuits T.J., Noomen A., Jellema A. and Van Boekel**(T2)**
3. M.A.J.S. (1999) Dairy technology- Principles of milk properties and processes. Marcel Dekker Inc.**(T1)**
4. Spreer E. (1998) Milk and dairy product technology. Marcel Dekker Inc.**(T3)**
5. Gupta R.P. (2003) Dairy India year Book 2007**(T4)**
6. Robinson R.K. Modern dairy Technology, Vol I Advances in Milk processing.**(T5)**
7. Outlines of Dairy Technology by Sukumar Dey, 1990, Oxford Univ. Press.**(T6)**

Reference books:

1. Lampert, Lincoln M. "Modern Dairy Products: Composition, Food Value, Processing, Chemistry,Bacteriology, Testing, Imitation Dairy Products". Chemical Publishing Company, 1998.**(R1)**

2. Selia, dos Reis Coimbra and Jose A. Teixeir "Engineering Aspects of Milk and Dairy Products" , CRC Press, 2009**(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Online testing kit for dairy analysis

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent advances in dairy quality analysis

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5

End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	2	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO 2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	3
CO 3	3	2	3	2	2	3	2	3	3	3	3	2	3	3	3
CO 4	2	2	2	2	3	3	2	3	3	3	3	3	3	3	3
CO 5	2	2	2	2	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 309**
Course title: **Mass Transfer in Food Processing**
Pre-requisite(s): **FT 212Fluid Mechanics and Mechanical Operations**
FT 302 Heat Transfer in Food Processing
Co- requisite(s):
Credits: 3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VI/03**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1	To understand the mechanism of mass transfer
2	To understand the various separation unit operation in food industries
3	To Interpret the design and operation of the mass transfer equipments
4	To account for the consequence of heat transfer in thermal analyses of engineering systems.
5	To understand the mechanism of Dryer will be understood

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand various modes of mass transfer
CO 2	Able to perform design calculation of distillation column
CO 3	Able to apply the knowledge of liquid-liquid and solid-liquid separation technology in food industries
CO 4	To apply the knowledge of crystallization and adsorption in food industries
CO 5	Able to understand the principles Psychometry and apply knowledge of drying operation in food processing.

Syllabus

FT 309 Mass Transfer in Food Processing

Module I: (9L)

Diffusion- Molecular diffusion of fluids, Ficks' Law, diffusivity Unsteady state diffusion in solids. Convective Mass transfer coefficient. Interphase mass transfer, individual and overall mass transfer coefficient.

Module II: (9L)

Distillation- Raoult's law, Henry's law, Vapour liquid equilibrium for ideal and non-ideal binary systems, Estimation of VLE using vapour pressure data and relative volatility. Batch distillation, Flash distillation, continuous distillation in Plate column. Design calculation by McCabe Thiele method. Steam distillation. Extractive distillation, azeotropic distillation, Alcohol distillation stills and columns.

Module III: (9L)

Liquid- Liquid Extraction - Equilibrium for immiscible and partially miscible systems, Use of triangular diagram. Liquid-liquid extraction equipment – mixer settlers and Extraction columns. Solid liquid Extraction – Leaching equipment with special reference to extraction of edible oil and sugar beet. Equilibrium curve, Cross flow/counter flow operation. Determination of number of stages, Supercritical fluid extraction – principles and application in food industry.

Module IV: (9L)

Crystallization: Supersaturation, Miers theory, Nuclei formation, Types of nucleation, Ostwald ripening, Kelvin equation Crystal growth , Theory of crystallization, Calculation of crystal yield, Batch and continuous crystallization, Fractional crystallization. Application in salt and sugar industry, Adsorption – Adsorbents and application in food processing, Adsorption isotherms Henry's, Langmuir, BET, Freundlich, Chemisorption, Single stage Multistage cross current adsorption. Adsorption Unit- Fixed bed equations, Breakthrough curve and analysis of fixed bed adsorption.

Module V: (9L)

Psychometry: Humidity, wet and dry bulb temperature, adiabatic saturation temperature, humid volume of air. Psychrometric charts. Measurement of humidity. Methods of humidification and dehumidification, Cooling towers and spray ponds. Drying: Principle rate of drying. Moisture content on dry and wet basis, bound and unbound moisture, equilibrium and free moisture. Drying rate. Time required for drying, Calculation of heat load, Mass and energy balance in dryer. Operation and application in food processing: Tray dryer, vacuum tunnel dryer, freeze drying, puff drying, rotary dryer, fluidized bed dryer, spray drying.

Text books:

1. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T1)**

2. Elements of Food Engineering by R.T. Toledo, **(T2)**
3. Food Process Engineering and Technology, **Zeki Berk), Academic Press.(T3)**
4. FOOD PROCESSING TECHNOLOGY, Principles and Practice, P. Fellows, CRC Press**.(T4)**

Reference:

1. Unit Operations In Food Engineering by Albert Ibarz and Gustavo V. Barbosa-Cánovas, CRC Press, 2003. **(R1)**
2. Unit Operations in Food Processing by R. L. Earle, 2nd Edition, Pergamon Press,Oxford,U.K, 2003. **(R2)**
3. Physical Properties of Foods &Foods Processing Systems by M. J. Lewis, EllisHorwood, England, 1987. **(R3)**
4. Unit Operations of Chemical Engg*by* McCabe and Smith **(R4)**
5. Unit operations in Agril processing *by* Sahay and Singh **(R5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Computational applications in food drying system

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Computational applications in food drying system

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
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CO 4	3	1	3	3	3	1	2	1	2	1	2	2	3	3	3
CO 5	3	1	3	3	2	1	2	2	2	1	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

INFORMATION SHEET

Course code: **FT 310**
Course title: **Thermodynamics and Refrigeration**
Pre-requisite(s):
Co- requisite(s):
Credits: 3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VI/03**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	To explain thermodynamic terminology and concepts appropriately
2.	To define appropriate system boundaries for analyzing a variety of thermodynamic components and systems
3.	To apply the basic of refrigerating and its applications in food engineering
4.	To develop knowledge in thermodynamic properties of food in relation to different unit operations.
5.	To use tables, charts, equations, and software, in conjunction with appropriate property diagrams, to fix states of a pure substance and determine relationships among pressure, temperature, specific volume, internal energy, enthalpy and entropy

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to demonstrate the principles of conservation of mass, conservation of energy, and the second law of thermodynamics to thermodynamic cycles.
CO 2	Able to build the ability to analyze the performance of vapor and gas power cycles
CO 3	Able to develop the ability to analyze the performance of vapor and gas refrigeration and heat pump cycles.
CO 4	Able to utilize states and performance parameters for vapor power cycles based on the Rankine cycle with superheat, reheat, and regeneration
CO 5	Able to collaborate and communicate with fellow students and the instructor in a professional manner

Syllabus

FT 310 Thermodynamics & Refrigeration

Module -I : (10L)

Zeroth&First law of thermodynamics-concept of temperature, Energy balance for closed system. Thermodynamic state and state functions. The reversible process. The adiabatic process. The constant volume and constant pressure process. Enthalpy, heat capacity. Mass and energy balance for open systems. Second law of thermodynamics and its application: Limitations of the first law of thermodynamics, statements of the law. Heat engine and heat pump / refrigerator. Mathematical statement of second law. Carnot cycle and Carnot Theorems. criterion of irreversibility, clausius inequality, entropy and its change calculation for ideal gases. Liquefaction process.

Module II : (9L)

Refrigeration : Basic refrigeration cycles and concepts: Elementary vapour compression refrigeration cycle with reciprocating, rotary and centrifugal compressor. Theoretical vapour compression cycle, Departure from theoretical vapour compression cycle, representation on T-S and P-H diagrams, Mathematical analysis of vapour compression refrigeration system. Refrigerants : Primary and secondary refrigerants, common refrigerant, Brine, their properties and comparison Multiple evaporation and compressor system: Application, on compressor system: dual compression, comparison of systems, control of multiple evaporator system.

Module III: (10L)

Refrigeration equipment : Compressor, condenser, evaporator, expansion valve, cooling tower. Basic elements of design, construction, operation and maintenance. Balancing of different components of the system, ice-bank ¬tank system. Refrigeration control: low and high side float valves, capillary tube, thermostatic expansion valve, automatic expansion valve, solenoid valve, high pressure and low pressure cutouts. Thermostat, overload protector, common defects and remedies. Refrigeration piping: Purpose, material, joints and fittings, water and brine pipe size selection. Refrigerated vehicle: truck, trawler. Working principleof Ice-flaker.

Module V : (9L)

Ultra low temperature refrigeration. Production of dryice. Absorption refrigeration system: simple vapour absorption refrigeration systems, Practical absorption system, refrigerant combinations, Absorption cycle analysis. Cooling load calculation: Types of load, design conditions for air cooling, air conditioning loads. Cold storage: Types of cold storage, types of load in cold storage, construction and maintenance of cold storage, insulating materials and vapour barrier. Cold storage: Types of cold storage, types of load in cold storage, construction and maintenance of cold storage, insulating materials and vapour barrier.

Module V: (7L)

Thermal properties of frozen and unfrozen food: Introduction to thermal properties, importance of thermal properties, experimental approach to measure thermal properties, modeling of thermal

properties of frozen and unfrozen foods.Systems forFreezing of solid and liquid food–Indirect contact and Direct contact Freezers.

Books

Text books:

1. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T1)**
2. Elements of Food Engineering by R.T. Toledo, **(T2)**
3. Food Process Engineering and Technology, **Zeki Berk), Academic Press.(T3)**
4. FOOD PROCESSING TECHNOLOGY, Principles and Practice, P. Fellows, CRC Press.(T4)

Reference:.

1. Earle RL. 1985. *Unit Operations in Food Processing*. Pergamon Press.(T1)
2. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*.Vikas Pub. (T2)
3. Refrigeration and air-conditioning. Richard C Jordan andGoyle B. Prirster (1956), Prentice Hall,(T3)
4. Refrigeration and air-conditioning. Dr.Manohar Prasad, (1993), WielyEstern, New Delhi.(T4)
5. An introduction to thermodynamics by Y V C Roy **(T5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Use of process simulator

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Introduction to molecular/statistical thermodynamics

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3

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

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 311**
Course title: **Food Business Management**
Pre-requisite(s):
Co- requisite(s):
Credits: **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VI/03**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	To Identify emerging issues that could change or enhance the agri and food business in the coming decades
2.	To understand the industry's main drivers of innovation, customers, technology and the environment and how to leverage them
3.	To Identify emerging opportunities for growth in both domestic and international markets Position the individual and his help to position his organization to compete effectively in food production and supply systems
4.	To extend the participants network by making new connections with peers from across the global food business industry.
	To prepare the detailed project report to food indudtry

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to analyze emerging issues that could change or enhance the agri and food business in the coming decades
CO 2	Able to evaluate the organization and function of the Food industry
CO 3	Able to develop understanding in the industry's main drivers of innovation, customers, technology and the environment and how to leverage them
CO 4	Able to construct the participants network by making new connections with peers from across the global food business industry.
CO 5	Able to collaborate and communicate with fellow students and the instructor in a professional manner

Syllabus
FT 311 Food Business Management

Module I: (8L)
Organisation & Management: Introduction to Organisation, Role of Managers, Managerial Skills, Basic Management Functions – Planning, Organising, Staffing, Directing (Leadership and Communication), Controlling, Executive Functions

Module II: (6L)
Human Resource Management: The HRM Process, Introduction to Manpower Planning, Recruitment, Selection, Training & Development, Performance Appraisal and Compensation Management.

Module III: (8L)
Marketing Management: Core Concepts of Marketing, Identifying a Marketing opportunity**,** Segmentation, Targeting and Positioning decisions, Dynamics of Consumer Behaviour, Significance of Marketing Research and Marketing Research Process, Introduction to Distribution & Logistics functions.

Module IV: (10L)
Financial Management: Goals of Financial Management- Profit Maximization Vs Wealth Maximization, Introduction to Accountancy, .Accounting Principles and Conventions, Double Entry system, Journal, Ledger, Trial Balance and Preparation of Final Account. Statement of Changes in Financial Position; Preparation of Funds Flow Statement, Preparation of Cash Flow Statement, Introduction to Financial ratios.

Module V: (8L)
Entrepreneurship & IPR: Concept of Entrepreneurship & Intrapreneurship, Characteristics and skills of entrepreneurs, **Sources of Finance -** Equity vs. Debt Capital, Sources of Equity Finance, Institutional finance, Venture Capital, Lease Finance, **Forms of Business Ownership -** Sole Proprietorship, Partnership, Corporations and other forms of ownership, Intellectual **Property Management:** Importance of innovation, Patents& Trademarks in Small Businesses, Introduction tolaws relating to IPR in India

Text books:

1. Principles of Agri Business Management by D. David and S Erickson 1987. Mc Graw Hill Book Co., New Delhi.
2. Agricultural Marketing in India by Acharya S S and Agarwal N L 1987. Oxford & ISH Publishing Co., New Delhi.
3. Marketing in the International Environment by Cundiff Higler 1993, Prentice Hall of India, New Delhi.

4. GAD implications of Denkel proposals - G S Batra & Narindev kumar (1994) Azmol Publications Pvt., New Delhi.

Reference Books

1. Management Process and Perspectives by Chhabra TN & Suria RK. 2001. Kitab Mahal.
2. International Economics by Jhingan ML. 2005.. 5th Ed. Virnda Publ.
3. Marketing Management by Kotler P. 2000. Prentice Hall.
4. Agricultural Economics by Reddy SS, Ram PR, Sastry TVN & Bhavani ID. 2004.. Oxford & IBH

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	3	2	3	3	1	2	1	3	3	3	3	3
CO 2	3	3	2	3	2	3	3	1	2	1	3	3	3	3	3
CO 3	3	3	2	3	2	3	3	1	2	1	3	3	3	3	3
CO 4	3	3	2	3	2	3	3	1	2	1	3	3	3	3	3
CO 5	3	3	2	3	2	3	3	1	2	1	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: FT 312
Course title: Dairy Technology Laboratory
Pre-requisite(s):
Co- requisite(s): FT 308 Dairy Technology
Credits: 2 L:00 T:00 P:04
Class schedule per week: 04
Class: IMSc
Semester / Level: VI/03
Branch: Food Technology

Course Objectives:

This course enables the students:

1.	Imparting knowledge about some indigenous dairy products
2.	Measurements, analysis and isolation of milk components.
3.	Experimental demonstration of chemical and physical reactions of milk components during typical processing conditions.
4	Knowledge about standardization and preparation procedures of indigenous dairy products

Course Outcomes

After the completion of this course, students will be:

CO1	Able to acquire skill of sampling milk and milk products
CO2	Able to conduct Physical, Chemical & Microbial analysis of milk and milk products
CO3	Able to understand development of different milk products.
CO4	Able to conduct Characterization of milk products.
CO5	Able to acquire knowledge of quality control of milk & milk products.

List of experiments

1. Sampling of milk and milk products
2. Platform tests of milk:

a. Organoleptic test
b. Sediment test
c. COB test
d. Alcohol test
e. Alcohol-Alizarin test
f. Titratable acidity and
g. pH milk

3. Determination of specific gravity of milk
4. Total solids and solid-not-fat using lactometer
5. Detection of milk adulterant

a. Added water
b. Starch
c. Cane sugar
d. Neutralizers and
e. Preservatives (formalin and hydrogen peroxide)
f. Synthetic milk (urea test, detergent test, common salt)

6. Alkaline phosphatase test to determine adequacy of pasteurization
7. Estimation of casein in milk, lactose, chlorides, Reichert-Meissel number and Polensky value
8. Curd/salt/Moisture in butter (Dean and Stark distillation)/Colouring matter in butter
9. Acid Valure/Peroxide value/ Iodine value/ Saponification value of ghee
10. Fat in cream
11. Total solids in cream
12. Development of some indigenous dairy products. Standardization and preparation of khoa/ice cream/ rasogulla
13. Microbial quality control in milk
14. Preparation and quality control of (a) curd (b) Paneer (c) Lassi
15. Preparation and testing of Cheese.

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York

5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
6. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

1. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
2. Robinson R.K. Modern dairy Technology, Vol I Advances in Milk processing.
3. Outlines of Dairy Technology by Sukumar Dey, 1990, Oxford Univ. Press..

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	3	3	3	3	2	1	2	2	3	2	3	3	3
CO2	3	1	3	3	3	2	2	1	2	2	3	2	3	3	3
CO3	3	1	3	3	3	2	2	1	2	2	3	2	3	3	3
CO4	3	1	3	3	3	3	2	1	2	2	3	2	3	3	3
CO5	3	1	3	3	3	3	2	1	2	2	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code:	**FT 313**
Course title:	**Food Engineering Laboratory**
Pre-requisite(s):	**FT 212Fluids Mechanics and Mechanical Operation** **FT 302 Heat Transfer in Food Processing**
Co- requisite(s):	**FT 309 Mass Transfer in Food Processing**
Credits:2	**L:00 T:00 P:04**
Class schedule per week:	**04**
Class:	**IMSc**
Semester / Level:	**VI/03**
Branch:	**Food Technology**

Course Objectives

This course enables the students to:

1.	Learn chemical engineering principles of various operations in Food Processing Industries
2.	Develop knowledge about practical applications of Chemical Engineering Unit Operations in Food Processing
3.	Learn experimental methods in Food Engineering
4.	Able to apply principles of food engineering in industry.
5.	Able to develop food engineering equipments for food processing

Course Outcomes

After the completion of this course, students will be:

CO1	Conversant with various fluid moving machineries and flow measurements
CO2	Familiar with various mechanical operations in Food Processing Industry.
CO3	Able to plan experiments and present, analyse and interpret the experimental data meaningfully
CO4	Capable to visualize and understand chemical engineering unit operations related to heat and mass transfer with application in Food Processing industry
CO5	Develop expertise in writing report to present their results and conclusions in a clear, concise and effective manner

List of experiments

1. Characterization of solids: size shape and density of solid food, Flowing characteristics-Bulk density, angle of repose of granular and powder food.
2. Calibration of Rotameter, Venturimeter and Orifice meter
3. Particle size analysis of granular/powder food.
4. Filters: Plate and Frame Press and Ultrafiltration
5. Steam distillation of essential oils
6. Power requirement in agitated vessel
7. Batch heating and cooling
8. Plate Heat Exchanger
9. Mixing of solids and paste: Determination of mixing index
10. Freezing of Food – plotting temperature vs time.
11. Heat penetration in food – Determination of lethality of a thermal process
12. Drying rate curve in Tray dryer
13. Drying rate curve in Fluidized bed dryer
14. Size reduction experiment
15. Humidity chart and cooling tower.

Text books:

1. Brennan JG, Butter JR, Corell ND & Lilly AVE. 1990. *Food Engineering Operations*. Elsevier.
2. Charm SE, McCabe WL, Smith JC & Harriott P.1993. *Unit Operations of Chemical Engineering*. McGraw Hills.

Reference books:

1. Sahay KM & Singh KK. 1994. *Unit Operation of Agricultural Processing*. Vikas Publ. House.
2. Singh RP & Heldman DR. 1993. *Introduction to Food Engineering*. Academic Press.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60

Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	**1**	**2**	**3**
CO1	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3
CO3	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3
CO4	3	3	3	3	3	3	3	1	2	3	3	3	3	3	3
CO5	1	3	2	1	3	3	1	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

Program Elective I			Program Elective II		
1	FT320	Food Additives & Ingredients	1	FT330	Food Packaging Technology
2	FT321	Flavour Chemistry Technology	2	FT331	Food Industry Waste Management
3	FT 322	Food Toxicology	3	FT332	Technology of Plantation crops and spices

COURSE INFORMATION SHEET

Course code: FT 320
Course title: Food Additives & Ingredients
Pre-requisite(s): FT 201 Food Chemistry
Co- requisite(s):
Credits:3 L:03 T:00 P:00
Class schedule per week: 03
Class: IMSc
Semester / Level: V/03
Branch: Food Technology
Name of Teacher:

Course Objectives

This course enables the students:

1.	To learn the diverse types of food additives, their functions and the properties of these additives, both in terms of chemical as well as physical properties.
2.	To build knowledge of international and national legislation on the use of food additives.
3.	To construct knowledge on Food additive classification and its mechanism of action
4.	To summarize advantages and risks of additives.
	To extend the participants network by making new connections with peers from across the global food business industry.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to explain how some foods in the diet can be combined to produce synergistic biological effects through their bioactive compounds
CO 2	Able to state the categories of additives, explain their purpose and discuss how additive use has shifted over the past century, including economic implications
CO 3	Able to compare and contrast the biological health effects of natural vs. artificial additives
CO 4	Able to outline differences between intentional and non-intentional food additives, and explain possible health implications resulting from effect of additives on biological systems
CO 5	Able to acquire competence in the proper use of additives in safe food production.

Syllabus
FT 320 Additives & Ingredients

Module I: (8L)
Definitions of Food Additives, Classification and Functions, Legitimate uses of Additives in foods, Intentional & Non Intentional additives, Indirect food additives; Difference between Additives & Adulterants, Food uses and functions in formulations; Toxicological and Safety Evaluation of Food Additives evaluation of food additives: Food Additives generally recognized as safe (GRAS), acute and chronic studies, NOAEL, ADI, Ld50.Indirect food additives.

Module II : (8L)
Naturally occurring Food Additives - Classification - Role in Food Processing – Health Implications. Food colors - What are food colors - Natural Food Colors - Synthetic food colors - types -their chemical nature - their impact on health. Preservatives - What are preservatives - natural preservation- chemical preservatives – their chemical action on foods and human system. Manufacturing and applications of fibres from food sources, fructooligosaccharides.

Module III: (8L)
Anti-oxidants & chelating agents - what are anti oxidants - their role in foods - types of antioxidants - natural & synthetic - examples - what are chelating agents - their mode of action in foods - examples. Surface active agents - What are surface active agents - their mode of action in foods -examples. Stabilizers & thickeners - examples - their role in food processing.Flavoring agents - natural flavors& synthetic flavors - examples & their chemical nature -role of flavoring agents in food processing.

Module IV : (8L)
Bleaching & maturing agents: what is bleaching - Examples of bleaching agents - What is maturing - examples of maturing agents - their role in food processing. Starch modifiers: what are starch modifiers - chemical nature - their role in food processing. Buffers - Acids & Alkalis - examples - types - their role in food processing. Anti-caking agents - their role in food processing, Humectants - definition on their role in food processing. Clarifying agents - definition examples - their role in food processing

Module V : (8L)
Ingredients used in food production e.g. sugar, starches/modified starches, fibres, proteins/protein hydrolysates and fats etc and their technology of production and application. Sugars and Sweeteners: Sugars, syrups, sugar alcohols, potent sweeteners, sugar products, caramelization. Sweetener chemistry related to usage in food Products. Artificial sweeteners &non nutritive sweeteners - special dietary supplements & their health implication - role in food processing. Proteins and Lipids as functional ingredients isolation, modification, specifications, functional properties and application in foods and neutraceuticals

Books:

1. Food Additive by Branen, A. L. et al (2001)., 2nd Edition, Marcel Dekker.
2. Encyclopedia of food and color additives by George, A. B. (1991)., Vol III, CRC Press.
3. Stephen AM. (Ed.). 2006. Food Polysaccharides and Their Applications. Marcel Dekker.

Fennema OR.1996. Food Chemistry. Marcel Dekker.

References:

1. Food proteins. Processing Applications by Nakai, S. and Modler, H. W (2000)., Wiley
2. Morton ID & Macleod AJ .1990. Food Flavours. Part A, BC. Elsevier.

Gaps in the syllabus (to meet Industry/Profession requirements)

Recent FSSAI guidelines for Food additives

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent FSSAI guidelines for Food additives

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	3	3	2	3	1	2	3	3	2	3	3	3
CO 2	3	2	3	3	3	2	3	1	2	3	3	2	3	3	3
CO 3	3	2	3	3	3	2	3	1	2	3	3	2	3	3	3
CO 4	3	2	3	3	3	2	3	1	2	3	3	2	3	3	3

CO 5	3	2	3	3	3	2	3	1	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: FT 321
Course title: Flavor Chemistry &Technology
Pre-requisite(s): FT201 Food Chemistry
Co- requisite(s):
Credits:3 L:03 T:00 P:00
Class schedule per week: 03
Class: IMSc
Semester / Level: V/03
Branch: Food Technology
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand mechanisms of flavor perception
2.	To be familiar with analytical methods of flavor analysis
3.	To develop non-enzymatic mechanisms of flavor formation
4.	To extend the participants network by making new connections with peers from across the global food business industry.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to summarize the manufacturing procedures used to produce the common food flavoring materials
CO 2	Able to discuss mechanisms of flavor release
CO 3	Able to predict off-flavor defects in foods and strategies of identification.
CO 4	Able to adapt with analytical methods of detecting flavour adulteration
CO 5	Able to improve competence in the proper use of additives in safe food production.

Syllabus

FT 321 Flavour Chemistry &Technology

Module – I : (8L)

Food flavor and its importance to consumers and food processors. Chemistry of substances responsible for taste and flavor-taste sensations, flavour enhancers, flavour potentiators or modifiers. Objectionable flavor in foods and methods of detection, Mechanism of flavor-food interactions, Monitoring Adulteration of Flavors, Methodology of sensory evaluation and determination of threshold levels as specified by BIS.

Module II: (8L)

Flavor and nutrition. Sources, extraction, delivery systems, Non-enzymatic methods of flavor formation, Lipid Oxidation methods of flavor formation, Enzymatic methods of flavor formation. Flavor changes during processing, preservation, packaging, and storage of foods. Effect of fermentation for flavor enhancement and formation. Means to reduce flavour losses during processing.

Module III: (8L)

Sensory perception of flavor: Senses of taste and smell, tasting versus sniffing, astringency, pungency, interaction of senses in flavor perception; taste, odor, and acceptance of flavor stimuli.Methods used in flavor evaluation. Statistical analysis of sensory data.

Module IV: (8L)

Flavoring constituents of various foods like meat, fish, milk, vegetables, fruits, fats & oils ,spices & herbs, cereals and pulses. Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid-ethanol in food flavors. Process and reaction flavors/volatiles in foods.

Module V: (8L)

Spices and herbs as food flavorings: Processing of basil, mint, saffron, cloves, tamarind, ginger, cardamom, chilies, pepper etc. for essential oils, extracts and oleoresins as the case maybe. Natural, Nature identical and Synthetic flavors: Definitions, chemical composition/constituents, extraction and preparation of flavors, Stability and utility of flavor preparations. EU, ASTA, Spice board of India and FSSAI restrictions for use of certain constituents in flavoring materials. Analyses (chemical, instrumental, and sensory) off flavors and flavorings in foods.

Books:

1. Food Chemistry by Fennema, Marcel Dekker.**(T1)**
2. Spices &Flavor Technology by Pruthi, J.s. **(T2)**
3. Ashurst PR. 1994. Food Flavorings. 2nd Ed. Blackie. **(T3)**
4. Burdock GA. 2004. Fenaroli's Handbook of Flavor Ingredients.5th Ed.CRC Press. **(T4)**
5. Deibler D &Delwiche J. 2004. Handbook of Flavor, Characterization: **(T5)**
6. Sensory Analysis, Chemistry and Physiology. Marcel Dekker. **(T6)**

References:

1. Heath HB &Reineccius G.1986. Flavor Chemistry and Technology. AVI Publ.**(R1)**
2. Taylor A. 2002. Food Flavour Technology. Sheffield Academic Press. **(R2)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Recent FSSAI regulations in Food Flavours

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent FSSAI regulations in Food Flavours

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	2	3	3	1	2	2	3	2	3	2	3	3	3
CO 2	3	1	2	2	2	1	3	1	2	1	2	1	3	3	3
CO 3	3	1	2	3	3	1	2	1	2	2	3	2	3	3	3
CO 4	3	1	2	3	3	1	2	2	3	2	3	2	3	3	3
CO 5	2	1	1	3	3	1	2	2	3	1	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 322**
Course title: **Food Toxicology**
Pre-requisite(s): **FT 203 Food Microbiology**
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **V/3**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To gain an understanding of microbial, chemical and natural toxicants and allergens those are indigenously present
2.	To be familiar with microbial, chemical and natural toxicants and allergens developed during food processing
3.	To build knowledge of Hazardous chemical compounds arising from processing and storage of foods
4.	Be able to assess risk and develop detoxification strategies with an aim to produce safe food

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand toxicants and allergens and their effects on human safety
CO 2	Able to discuss Food Poisoning, Food borne infections and diseases
CO 3	Able to predict the toxins in foods due to chemical food additives, environmental toxicants and strategies for their reduction.
CO 4	Able to know how they can regulate Food toxicants; Bacteriotoxins and Mycotoxins in food products
CO 5	Able to improve their ability to safe food production.

Syllabus

FT 322 Food Toxicology

Module -I: (9L)

Definition scope and general principles of food toxicology; manifestation of toxic effects; classification of food toxicants; factors affecting toxicity of compounds; methods used in safety evaluation-risk assessments.

Module - II: (9L)

Toxicants and allergens in foods derived from plants, animals, marine, algae & mushroom; Microbial toxins; Food Poisoning; Food borne infections and disease.

Derived Food toxicants- Processing & Packaging; Toxicants generated during food processing such as nitrosamines, acryl amide, benzene, dioxins and furans; persistent organic pollutants.

Module-III: (9L)

Toxicology & food additives; Toxicological aspects of nutrient supplements; Chemicals from processing such as fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, agrochemicals; heavy metals; intentional and unintentional additives. Food toxicants; Bacteriotoxins (botulinm and other bacterial exotoxins). Mycotoxins (Aflatoxins, trichothecenes, ochratoxins)their production, properties and regulation

Module -IV: (9L)

Toxicants formed in processed foods(food mutagens, carcinogens); Toxicants formed in processed foods. Hazardous chemical compounds arising from processing and storage of foods. Heating and chemical changes to Frying food. Conservation , Radiation and Microwave energy. Polycyclic aromatic hydrocarbons.

Module -V: (9L)

Environmental Toxicants (heavy metals. Pesticides, industrial contaminants): Dose effect relationship. Toxicity testing. Health effects of nitrates, nitrites and N- nitroso compounds. Heavy metals and other toxic elements (lead, mercury, cadmium and others) Radionuclide. Diphenyls, dioxins and pentachlorophenol.

Text Books:

1. Branen AL, Davidson PM &Salminon S. 1990. Food Additives. Marcel Dekker.
2. Concon JM.1988. Food Toxicology - Principles & Concepts. Marcel Dekker.
3. Hathcock JN. (Ed.). 1982. Nutritional Toxicology. Vol. I. Academic Press.
4. Rechcigl M Jr. 1983. (Ed.). Handbook of Naturally Occurring Food Toxicants. CRC Press.

Reference Books:

1. Shabbir S. 2007. Food Borne Diseases. Humana Press.
2. Steven T. 1989. Food Toxicology: A Perspective on Relative Risks.
3. Tweedy BG.1991. Pesticide Residues and Food Safety. Royal Society of Chemistry.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	3	3	3	3	1	3	3	3	2	3	3	3
CO 2	3	1	3	3	3	3	3	1	3	3	3	2	3	3	3
CO 3	3	1	3	3	3	3	3	1	3	3	3	2	3	3	3
CO 4	3	1	3	3	3	3	3	1	3	3	3	2	3	3	3
CO 5	3	1	3	3	3	3	3	1	3	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD	CO1	CD1, CD2, CD8

	projectors/OHP projectors		
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 330**
Course title: **Food Packaging Technology**
Pre-requisite(s):
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VI/3**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand Food Packaging and its importance
2.	To be familiar with Food preservation by Packaging
3.	To build knowledge
4.	Be able to produce safe food
5.	To acquaint the students with detail knowledge of modern technology involve in food packaging and their applications.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand Packaging materials, functions of protective packaging and types of Packaging
CO 2	Able to discuss the food Package Design and Features
CO 3	Able to predict the effects of Packaging materials on quality of packaged food
CO 4	Able to know about the regulation of Packaging materials
CO 5	Able to improve quality of packaging materials

Syllabus

FT 330 Food Packaging Technology

Module I: Definition of Packaging, Benefits of Packaging, Types of Packaging, Principles of Food Packaging, Climate Hazards on Packages, Functions of Packages. Protective Packaging – Principle, Materials, Functions. Design Fundamentals- Need for Chances in Package Design, Features of Effective Design, Design Factors, Customer Appeal, Packaging Graphics, Package Colour. Food preservation methods, Packaged product quality and shelf life - Factors affecting product quality and shelf life, Chemical/biochemical processes, Physical and physico-chemical processes, Migration from packaging to foods [9]

Module II: Packaging of food in Metal cans - Raw materials, Coatings, film laminates and inks, Processing of food and drinks in metal packages, Shelf life of canned foods
Packaging of food in glass containers- Glass containers market sectors for foods and drinks, Attributes of food packaged in glass containers, Environmental profile
Paper and paperboard packaging- Paper and paperboard – fibre sources and fibre separation (pulping), Paper and paperboard manufacture, Properties of paper and paperboard, Package types, Environmental profile. [9]

Module III: Plastics in food packaging - Use of plastics in food packaging, Types of plastic used in packaging – Polyethylene, Polypropylene (PP), Polyethylene terephthalate, Ethylene vinyl acetate (EVA), Polyamide (PA), Polyvinyl chloride (PVC), Polyvinylidene chloride (PVdC), Polystyrene (PS), Acrylonitrile butadiene styrene (ABS), Ethylene vinyl alcohol (EVOH) etc. Coating of plastic films – types and properties, Acrylic coatings, PVdC coatings, PVOH coatings, Low-temperature sealing coatings (LTSCs), Metallising with aluminium, Extrusion coating with PE, Printing and labelling, Food contact and barrier properties, Sealability and closure, Retort pouch. [9]

Module IV: Active and intelligent packaging, Active packaging techniques, Intelligent packaging techniques- Time-temperature indicators (TTIs), Factors affecting the effectiveness of antimicrobial packaging. Non-migratory bioactive polymers (NMBP) in food packaging, Advantages of NMBP, limitations, Novel MAP applications for fresh-prepared produce, Novel MAP gases. [9]

Module V: Environmental and waste management issues with plastic packaging, Legislative issues, developing novel biodegradable materials, Modern packaging systems: Green plastics for food packaging, Recycling packaging materials: The recyclability of packaging plastics, improving the recyclability of plastics packaging, Testing the safety and quality of recycled material, Using recycled plastics in packaging. [9]

Text Book

1. Ahvenainen R. 2001. Novel Food Packaging Techniques.CRC.

2. Crosby NT. 1981.Food Packaging Materials. App. Sci. Publ.
3. Mahadeviah M &Gowramma RV. 1996. Food Packaging Materials. Tata McGraw Hill.
4. FAPaine& H Y Paine, 1992, springer A Handbook of Food Packaging. Blackie.

Reference book

1. SJ. 1980. Developments in Food Packaging. App. Sci. Publ.
2. Rooney ML. 1988. Active Food Packaging.Chapman& Hall.
3. Sacharow S & Griffin RC.1980.Principles of Food Packaging. AVI Publ.
4. Stanley S & Roger CG. 1998. Food Packaging. AVI Publication.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	1	3	3	3	1	3	2	2	3	2	3	3	3	3
CO 2	2	1	3	3	3	1	3	2	2	3	2	3	3	3	3
CO 3	2	1	3	3	3	1	3	3	2	3	2	3	3	3	3
CO 4	1	1	1	3	2	1	1	3	2	3	2	2	3	3	3
CO 5	3	1	3	3	3	3	3	2	2	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 331**
Course title: **FT331 - FOOD INDUSTRY WASTE MANAGEMENT**

Pre-requisite(s): **Fundamental knowledge of food processing operations.**

Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **V/3**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To impart the knowledge regarding various types of waste generated from various food processing industries and their effective treatment and disposal management.
2.	To understand the principal legislation governing waste management.
3.	To apply the methodology for waste identification, segregation, classification and disposal.
4.	To understand the roles and responsibilities of all parties involved in the waste management chain.
5.	To identify opportunities for waste minimisation.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to explain and apply the technical knowledge of waste management in food industry.
CO 2	Explain the hierarchical structure in solid waste management and a requirement for an integrated solution.
CO 3	Examine the technical points that are required to set up a solid waste management system.
CO 4	Apply the legal legislation related to waste management.
CO 5	Set up a food industry waste management system.

FT331 - FOOD INDUSTRY WASTE MANAGEMENT

Module -I:

By products of and their utilization from Cereal (Corn, wheat, rice), Oilseeds (Groundnut, Mustard, Sunflower, coconut, cottonseed, etc. Pegion pea, black and green gram, bengal gram etc.)

Module - II:

By Product of and their utilization from :1. Fruits (Apple, grape, papaya, orange, citrus, mango), Dairy (Cream/Butter, Chees/Paneer), Tea leaves, coffee beans, shewnut. Other important by products : Leather, Gelatin, Adhesives- animal gues, protein based, starch based

Module III: Characterization of food industry waste

Introduction to Environmental Engineering. Air and Water Pollution and control methods. Solid waste disposal. BOD, COD, TOD, pH, dissolved O2, O3, total organic content, types of solids (Floatable, suspended settable), Froth floatation & floatation techniques, sedimentation & screening, types of sedimentation.

Module IV:

Biological Oxidation

Various types of biological reactions occurring in biological oxidation (Methano-genesis, nitrification, denitrification, blame, synthesis, endogenous respiration, photosynthesis type of air diffusers, lagoons, oxidation ditches, rotating biological contactor, trickling filters

Module -V:

Advanced (Tertiary treatment)

Polishing ponds/ lagoons, DAF techniques, micro filters/strainers, removal of nitrogen, phosphorus, sulphur.

Text Book:

1. Tchobanoglous, G., Burton, F. L., Stensel, H. D., Metcalf and Eddy, Inc. "Wastewater Engineering Treatment and Reuse", Tata McGraw-Hill, 2003
2. Waste Management for the Food Industries, I. S. Arvanitoyannis, Academic Press, 2008.
3. Food Industry Wastes, M.R.Kosseva and C. Webb. Academic Press, 2013
4 Environmental Impact Assessment L W Canter, McGraw Hill, 1997

Reference books:-

1.Environmental Engineering, H. S. Peavy, D.R. Rowe, G. Tchobanoglous Mcgraw Hill.
2.Waste Management for the Food Industries by Ioannis S. Arvanitoyannis, Elsevier Academic Press 2008.
3. Food Industry Wastes Assessment and Recuperation of Commodities, Maria R Kosseva and Colin Webb, Food Science and Technologies International Series, Elsevier Academic Press 2013.
4. Russell, D. L. "Practical wastewater treatment", John Wiley & Sons, Inc., Hoboken, New Jersey, 2006.

5. Bartram, J. Water Quality Monitoring: A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. United Nations Environment Programme,World Health Organization, Taylor & Francis, 1996.

Gaps in the syllabus (to meet Industry/Profession requirements)

Recent Indian food waste disposal regulations

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent Indian food waste disposal regulations

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	3	3	1	3	1	1	3	3	3	3	3	3
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CO 3	3	1	3	3	3	1	3	1	1	2	3	2	3	3	3
CO 4	3	1	3	3	3	1	3	3	1	3	3	3	3	3	3
CO 5	3	2	3	3	3	1	3	1	1	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
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CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 332**
Course title: **Technology of Plantation Crops and spices**
Pre-requisite(s): **FT203 Food Chemistry**
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VI/03**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand the processing of plantation crop.
2.	To be familiar with analytical methods of used for plantation crop products
3.	To develop knowledge on engineering aspects of plantation crop processing machineries
4.	To understand and apply different functional ingredients with different product matrix
5.	To make the students aware of post harvest technology and management of spices, plantation crops, medicinal and aromatic plants.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to summarize the manufacturing procedures used to produce the plantation crop materials
CO 2	Able to discuss about varieties of methods of plantation crop analysis
CO 3	Able to predict defects in plantation crop products and make upto international standards. .
CO 4	Able to adapt with the active ingredients of the plantation crop.
CO 5	Able to improve competence in the proper use of plantation crop in safe food production.

FT 332-Technology of Plantation Crops and spices

Module -I :

Plantation Crops - Description of various types of Plantation crops, viz., coconut, areca nut, coffee, tea, cocoa etc. Processing and preservation methods. Value-added products shelf-stable products viz., coconut water bottling, desiccated coconut powder, coffee concentrate, instant coffee powder, instant tea powder, cocoa processing.

Leafy vegetables - Description of various types of leafy vegetables, viz., hibiscus, curry leaves, coriander leaves, etc. Their composition, nutritive value, health benefits. Preservation methods and packaging techniques.

Module –II :

Spices & Condiments - Description of various types of spices and condiments, their composition, functional properties, flavouring agents. Nutritive value of spices and their health benefits. Intermediate Moisture Products – Intermediate Moisture Products viz., ginger paste, ginger – garlic paste, tamarind paste, tamarind concentrate. Their importance in culinary preparations. Flavour retention and packaging methods.

Module -III :

Spice Powders & Curry Powders : Their importance in culinary preparations, their preparation methods, grinding and packaging methods for spice powders like chilli powder, turmeric powder, ginger powder, garlic powder; and Masala Powders for chicken masala, meat masala, biryani masala, chat masala etc. Importance of Cryogenic grinding of spices.Spice Oils – Concept and importance of spice oils from spices like and condiments like clove, cardamom, cinnamon etc. Their application in food processing, and extraction methods of spice oils by various techniques, viz., solvent extraction, steam distillation etc.

Module IV:

Extraction of Oleoresins – Concept and importance of oleoresins in food processing, processing of spices like chili, turmeric, pepper, ginger etc. for solvent extraction of oleoresins. Oleoresins technology, desolventization methods, regulatory and statutory requirements for oleoresin processing. Extraction of Natural Food Colors - Extraction of Natural Food colors from paprika, turmeric, blue grapes, beet root etc. Their importance in food processing.

Module –**V :**

Herbs – Description of various types of herbs, viz., Basil, Chives, Cilantro, Dill, Coriander, Mint, Oregano, Parsley, Chives, Borage and Avocado leaves, Rose marry, Saga, Tarragon, Thyme, Winter savory and bolbo leaves, Papalo, Pipicha and Safflower. Their nutritive value & health benefits, their processing and Post harvest handling. Packaging methods for processed products.

TEXTBOOKS :

1. Spices & Condiments, J S Pruthi, National Book Trust, New Delhi (2001).**(T1)**
2. Spices : Morphology, History , Chemistry., J W Parry, Chemical Publishing Co., New York (1969).**(T2)**
3. Leafy Spices, V Prakash, CRC Press, Florida (1990).**(T3)**

References:

1. Spices and Condiments by J. Venkatesh and Raviraja Shetty G.ecourseonline**(R1)**

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
First Quiz	10
Mid Semester Examination	25
Second Quiz	10
Teacher's Assessment	5
End Semester Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	1	3	3	3	2	3	1	3	3	3	3	3
CO 2	3	1	3	1	3	3	3	2	3	1	3	3	3	3	3
CO 3	3	2	3	2	3	3	3	2	3	3	3	3	3	3	3
CO 4	3	1	3	1	3	3	3	2	3	1	3	3	3	3	3
CO 5	3	2	3	2	3	3	3	2	3	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 401**
Course title: **Bakery and Confectionary Technology**
Pre-requisite(s):
Co- requisite(s):
Credits: 4 **L:03** **T:01** **P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	Impart fundamental knowledge of bakery, confectionery and convenience products and give brief introduction of recent development in bakery, confectionery and convenience product technology.
2.	Demonstrate the knowledge of bakery, confectionery and convenience foods.
3.	Demonstrate skills involved in production of various baked products.
4.	Understand about the machinery involved in manufacture of these products
5.	To utilize knowledge on the methods of packaging, shelf life and food factors affecting the product quality

Course Outcomes

After the completion of this course, students will be:

CO 1	Explain the different ingredients used in bakery
CO 2	Explain the different working temperatures for bakery products
CO 3	Define the bread faults and remedies of bakery products
CO 4	Draw and explain the layout of a bakery
CO 5	Write recipes of different breads, pastries and other products

Syllabus

FT 401 Bakery and Confectionary Technology

Module - I: (9L)

Introduction to baking; Bakery ingredients and their functions; Machines & equipment for batch and continuous processing of bakery products. Lay out designing of bakery industry.

Module- II : (9L)

Bakery and confectionary industry ; raw materials and quality parameters; dough development; methods of dough mixing; dough chemistry; rheological testing of dough-Farinograph, Mixograph, Extensograph, Amylograph/ Rapid Visco Analyzer, Falling number, Hosney's dough stickiness tester and interpretation of the data.

Module- III: (9L)

Technology for the manufacture of bakery products – bread, biscuits, cakes and the effect of variations in formulation and process parameters on the quality of the finished product; quality consideration and parameters; Staling and losses in baking. different working temperatures for bakery products

Module - IV: (9L)

Chocolate Processing Technology, Compound coatings & Candy Bars, Tempering technology, Chocolate hollow figures, Chocolate shells, Enrobing technology, Manufacture of candy bars, Presentation and application of vegetable fats. Production of chocolate mass.Sugar confectionery manufacture, General technical aspects of industrial sugar confectionary manufacture, Manufacture of high boiled sweets- Ingredients, Methods of manufacture- Types- Center- filled, lollipops, coextruded products. Manufacture of gums and jellies- Quality aspects.

Module- V: (9L)

Quality characteristics of confectionery ingredients; technology for manufacture of flour , fruit, milk, sugar, chocolate and special confectionery products; colour, flavor and texture of confectionery; standards and regulations ; machineries used in confectionery industry.Manufacture of Miscellaneous Products, caramel, Toffee and fudge- Liquorices paste and aerated confectionery, Lozenges, sugar panning and Chewing gum, Count lines Quality aspects, fruit confections. Defects in bakery products.

Text Books:

1. Extrusion of Food, Vol 2; Harper JM; 1981, CRC Press.
2. Bakery Technology & Engineering; Matz SA; 1960; AVI Pub.

References:

1. Up to-date Bread Making; Fance WJ &Wrogg BH; 1968, Maclasen& Sons Ltd.
2. Modern Cereal Chemistry; Kent-Jones DW & Amos AJ; 1967, Food Trade Press Ltd

Gaps in the syllabus (to meet Industry/Profession requirements)

Recent developments in bakery and confectionary machineries

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent developments in bakery and confectionary machineries

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	3	2	1	3	1	2	2	2	2	3	3	3
CO 2	3	2	2	3	2	1	3	1	2	2	2	2	3	3	3
CO 3	3	2	2	3	2	2	3	1	2	2	2	2	3	3	3
CO 4	3	2	3	3	2	1	3	1	2	2	2	3	3	3	3
CO 5	3	2	2	3	2	1	3	1	2	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 402**
Course title: **Food Laws, Safety and Quality**
Pre-requisite(s):
Co- requisite(s):
Credits: 4 **L:03 T:01 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VII/04**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To illustrate different type of food hazards, physical, chemical and biological in theindustry and food service establishments
2.	To apply skilled knowledge of laws, safety and quality for food safety surveillance
3.	To be aware about the regulatory and statutory bodies in India and the world
4.	To develop strategies in the processingof food meeting global standards
5.	To understand basic principles of HACCP, SQF and ISO and sanitation in general.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to adapt thorough knowledge of food hazards-physical, chemical and biological in the industry and food service establishments
CO 2	Able to discuss on regulatory and statutory bodies in India and the world
CO 3	Able to examine the sources of food borne risk.
CO 4	Able to elaborate the multiple functions of regulatory agencies in India
CO 5	Able to select required laws and regulations pertaining to food processing.

Syllabus
FT 402 Food Laws, Safety and Quality

Module I: (9L)
Food safety and safe food; Food Contaminants & Hazards (Microbial, Chemical, Physical), Chemicals from processing like fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, pesticides and herbicides; Chemical formed duringprocessing -trans fatty acids, pyrolytic and thermal decomposition products, urethane, mycotoxins, scrombotoxin, migration, Cross - contamination, nitrates and related products, Addites- sulfites, phenolic antioxidants, non-nutritive sweeteners, colour additives, fat substitutes, chemical preservatives, Veterinary drugs and antibiotics. Allergens, goitrogens, lathyrogens, alkaloids, lectins, aflatoxins. Food allergy and intolerance; Food Adulteration; Detoxication strategy.

Module II: (9L)
Implementation of FSIS program for pathogen reduction; prevention of food-borne illness, Existing and emerging pathogens due to globalisation of food trade; Toxicity due to microbial toxins including botulinum and staphylococcal toxins, mycotoxin and due to other food pathogens; dose-response, model risk assessment, management and communication; exposure assessment, monitoring; Structured model for microbial risk reduction, microbial biofilms, prevention of microbial hazards; Sanitation, antimicrobial plastics, intelligent packaging, headspace gas modification;, Risk assessment; Systems of safety evaluation such as HACCP, GMP; Testing of food ingredients & additives; Animal studies including LD50; Ames test for teratogenicity; Natural toxic constituents in plant foods; Shellfish poisoning.

Module III: (9L)
Salient features of Food Safety & Standards Act, 2006,Structure of FSSAI, Administrative set up at the State level. Roles and Responsibilities of different Food safety Regulators, Food Safety Commissioner, Designated Officer, Food safety Officer, Adjudicating Officer Licensing and registration, Licenses to be granted by Central Licensing Authority, Documents/ Format required for Registration/ Licensing; Food Packaging & labelling (Packaging types, understanding labelling rules & Regulations, Nutritional labelling, labelling requirements for pre-packaged food as per CODEX); Organic food, Identifying Organic foods, Advantages, Certification Process, Labelling, GM food, Main issues of concern for Human Health, regulation.Irradiated Food, Labelling of Irradiated Food. Regulation regarding Nutraceuticals & Functional Foods.

Module IV: (9L)
Responsibilities of the Food service operator, consumer protection, food audit. Surveillance networks, Consumer and food service operator education,World Trade Organization (WTO), Principles of trading system. SPS and TBT, Differences between SPS & TBT. WTO agreement on the application of SPS measures. Food & Agriculture Organization (FAO) FAO in India, Technical Cooperation programmes, Bio-security in Food and Agriculture, World Health Organization (WHO), World Animal Health Organization (OIE), International Plant Protection Convention (IPPC); Codex Alimentarius Commission - Codex India – Role of Codex Contact

point, National Codex contact point (NCCP), National Codex Committee of India – ToR, Functions, Shadow Committees etc.

Module V: (9L)
Good Hygienic Practices (GHP), Good Manufacturing Practices (GMP), HACCP, ISO 9001 (Quality Management System), ISO 22000 (Food Safety Management System), Traceability, Food Recall, Need for Food analysis, Accreditation of Food Laboratory, Referral labs. Risk analysis and management in food safety, What is food surveillance, Steps to be taken for reporting and dealing with food incidents. Food alerts. Offences in food, Trials (Case Study)and procedure to launch prosecution; Responsibilities of the Food service operator, consumer protection, food audit. .

Text books:

1. Environmental regulation and food safety by Veena Jha.**(T1)**
2. Microbiological safety of food by Hobbs, 1973**(T1)**
3. Emerging technologies; food process by Da-wen, 2005**(T1)**
4. Food safety by Laura K Egendorf, 2000**(T1)**
5. Food Regulation: Law, Science, Policy, and Practice by Fortin, N.D . John Wiley, 2009. **(T1)**
6. Food Security, Biological Diversity and Intellectual Property Rights by Lightbourne, Muriel Ashgate, 2009. **(T1)**

Reference books:

1. International standards of food safety by Naomi Rees, David Watson, 2000**(R1)**
2. Codex alimentarius by FAO & WHO, 2007**(R1)**
3. Mehta, Rajesh and J. George "Food Safety Regulation Concerns and Trade : The Developing Country Perspective". Macmillan, 2005. **(R1)**

Gaps in the syllabus (to meet Industry/Profession requirements)

Up to date regulations From FSSAI

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Up to date regulations From FSSAI

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10

Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	3	3	2	3	3	3	2	3	1	2	3	3	3
CO 2	3	2	3	3	2	3	2	3	2	3	1	2	3	3	3
CO 3	3	2	3	3	2	3	3	2	2	3	1	2	3	3	3
CO 4	3	2	3	3	2	3	2	3	2	3	1	2	3	3	3
CO 5	2	2	3	3	2	2	3	3	2	3	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
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CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 403**
Course title: **Advanced Food Chemistry and Microbiology**
Pre-requisite(s): **Basis of Food Microbiology and Chemistry**
Co- requisite(s):
Credits: 4 **L:03 T:01 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	To build a comprehensive understanding about foodborne pathogens regarding their prevalence and virulence, interactions with the environment and the host.
2.	To develop molecular biology and other cutting-edge techniques to detect and identify microorganisms associated with foods.
3.	To build knowledge on bacterial signalling and their possible roles in biofilm formation and pathogenesis of food borne pathogens
4.	To critically Interpret the current literatures of foodborne pathogens.
5.	To build a comprehensive understanding about advanced application of food chemistry

Course Outcomes

After the completion of this course, students will:

CO 1	Able to build a comprehensive understanding about virulence and pathogenesis of foodborne pathogens and their interaction with environment and the host, as well as applications of knowledge in food industry and implications to human health.
CO 2	Able to adapt the advanced techniques and develop the basic skills to apply these techniques to solve food industry problems as well as research questions.
CO 3	Able to construct in depth knowledge about the current literatures on foodborne pathogens.
CO 4	Able to locate, critically evaluate, and apply scholarly literature and other scientific information to design experiments and solve problems in food microbiology and foodborne pathogens and related disciplines.
CO 5	Able to develop adequate knowledge to apply food chemistry principle to develop new products

Syllabus

FT 403 Advanced Food Chemistry and Microbiology

Module I: (10 L)

Overview of microorganisms and their growth in foods; Food preservation and biopreservation; Foodborne pathogens: Prevalence, virulence and pathogenesis of foodborne pathogens and their interaction with environment and the host; Major food- and water-borne pathogens - their impacts on food safety and environment, Control of food- and water-borne pathogens in high risk foods. Detection of food- and water-borne microbes.

Module II: (10 L)

Foodborne illness overview and new emerging foodborne pathogen; *Listeria monocytogenes* and its pathogenesis; *E. coli* O157:H7 and its reservoir; non-O157 Shiga toxin producing *E. coli* (STEC) Prophage and Stx; *Salmonella spp.* and its pathogenesis; *Yersinia spp.* and its pathogenesis; Molecular mechanisms of *Campylobacter jejuni*-host cell interactions; *Shigella spp., Vibrio spp., Staphylococcus aureus* and its pathogenesis; Spore forming bacteria focusing on *Clostridium botulinum, Clostridium perfringens.*

Module III: (10 L)

Toxic molds, infectious agents and bacterial antibiotic resistance - Toxic molds, mycotoxins and mycotoxicosis; Foodborne virus focusing on hepatitis A virus and norovirus; foodborne virus and mycotoxins ; Prion diseases ; Agricultural antibiotic use, bacterial antibiotic resistance and associated molecular mechanism; Detection of microorganism in foods, biofilm and bacterial signaling- Food microbiological samples, sampling plan and conventional detection methods, Immunological methods and DNA based assay; Phage based assay, molecular fingerprinting and biosensors in pathogen detection; Biofilm formation and bacterial signalling.

Module IV: (10 L)

Water:- Water binding and chemical mediated water.Food protein: Classification, physicochemical properties. Reactions involved in processing. Reactions with alkali. Enzyme catalyzed reactions involving hydrolysis and proteolysis. . theories of formation of texturiesed proteins. Lipids :- Reactions involved during deep frying of foods viz., autoxidantion of saturated acyl lipids and polymerization. Lipopotein and membrane; definition, classification and involvement in the formation of biological membrane. Unsaponsifiable matter contents in various fats and oils.

Module V: (10 L)

Different carbohydrates in food products such as starch, cellulose, sugars, pectin, fibre etc. Viz., liner, branched and modified and their significance in diet; Their chemistry & changes in them during processing; Chemical & enzymic modification; Interactions with other food constituents and their implications; Special application of carbohydrates in gels, emulsions, stabilisation of food systems, simulated and low-fat foods, edible packages etc. Enzymatic degradation of polysaccharides, viz. agar, alginate, carrageenam, gums and starch. Production of dextrans and malto dextran. Food Enzymes:- Hydrolases and lipases, utilization in food industry, effect of inhibitors, pH and temperature. Minerals in food :- Main elements, trace elements in eggs, cereal and cereal products vegetables and fruits. Food additives:- Vitamins, amino acids, minerals,

Aroma substance flavour enhancersmonsodium glutamate, 5-nucleotides. Sugar substitutes, sorbital. Sweeteners-saccharin, cyclamate. Food colour. Anti-nutritional factors and food contaminant: Toxic-trace elements, radio nuclides.

Text books:

1. Food Microbiology: Fundamentals and Frontiers, Michael P. Doyle, Robert L. Buchanan - 2012**(T1)**
2. Advances in food and nutrition research by Steve L. Taylor**(T2)**
3. Glycochemistry Principles, Synthesis and application by Wang, Peng and George, 2001**(T3)**
4. Food Chemistry by Belitz and Grosch, 2004**(T4)**
5. Sugar Chemistry by Shallemberger and Birch, 1975**(T5)**
6. Advances in carbohydrate chemistry& biochemistry by Derek HortonFood chemistry by Meyer, 1974**(T6)**

Reference books:

1. International standards of food safety by Naomi Rees, David Watson, 2000**(R1)**
2. Codex alimentarius by FAO & WHO, 2007**(R2)**
3. Mehta, Rajesh and J. George "Food Safety Regulation Concerns and Trade : The Developing Country Perspective". Macmillan, 2005.**(R3)**
4. Human nutrition by Alfin-Slater, 1979 **(R4)**
5. Human nutrition by Burton, BT, 1976 **(R5)**

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	3	3	2	3	3	3	2	3	1	2	3	3	3
CO 2	3	2	3	3	2	3	3	3	2	3	2	2	3	3	3
CO 3	3	2	3	3	3	3	3	3	2	3	1	2	3	3	3
CO 4	3	2	3	3	2	3	3	3	2	3	2	2	3	3	3
CO 5	3	3	3	3	2	3	3	3	2	3	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
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CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 404**
Course title: **Fats and Oils Technology**
Pre-requisite(s): **Basic knowledge in Food Processing and Preservation**
Co- requisite(s):
Credits: 4 **L:03 T:01 P:00**
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VII/04**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To demonstrate the general knowledge on the agronomy, production andtrade of the current domestic and offshore oilseeds.
2.	To develop the basics of the critical parameters involved in theextraction, refining, bleaching, deodorization of fats and oils and their modifications into functional shortenings and the subsequent handling and the preservation of their quality.
3.	To apply the basic chemistry of fats and oils with focus in theunderstanding of the relevance of their physicochemical andbiochemical properties in their functions as ingredients in foods.

Course Outcomes

After the completion of this course, students will:

CO 1	Able to adapt a comprehensive understanding about agronomy, production andtrade of the current domestic and offshore oilseeds.
CO 2	Able to build an integrated view of the chemical, physical and nutritional properties of fats and oils.
CO 3	Able to develop knowledge on physicochemical and biochemical properties of oil , their spoilage and preservation skill.
CO 4	Able to discuss a broad and in depth knowledge about the extraction, refining, bleaching, deodorization of fats and oils, their modifications into functional shortenings, subsequent handling and the preservation of their quality.
CO 5	Able to elaborate detailed knowledge of the factors inherent in processing, storage and cooking of fats and oils which affect stability, nutritional quality and safety of foods.

Syllabus
FT 404 Fats and Oil Technology

Module I: (9L)
Importance of fats and oils in foods; Sources, composition and properties of fats and oils (plant and animal origin); Chemistry & Stability of fats & oils; Triglycerides and phospholipids; emulsions and emulsifiers; Evolution of business initiatives: Functionality of fats & oils in food systems; Supply chain and trade challenges.

Module II: (9L)
Processing of fats and oils- Extraction of oil by mechanical expelling and solvent extraction and obtaining deoiled cakes suitable for edible purposes. Processing of other plant sources of edible oils and fats like coconut, cotton seed, rice bran, maze germ, etc.Refining, Bleaching , Deodorization , Storage & Handling; Newer techniques of refining of oils and fats; Extraction, refining and processing of rice bran oil. Chemical adjuncts from oil processing.

Module III: (9L)
Modification of fats and oils -Physical modification (Blending, Emulsification, Fractionation, winterisation), Chemical modification (Hydrogenation, esterification); Votation; Plastic fat – Winterization, hydrogenation, esterification, inter-esterification and emulsification; Application of plastic fat inbakery, confectionary (including cocoa butter replacers), shortenings, margarine processing; Manufacture and evaluation of auxiliary materials such as activated earth and carbon, Ni catalysis and hydrogen.

Module IV: (9L)
Animal fats(lard, tallow, ghee etc.)-sources-nutritive value- industrial application; Changes during storage of oil seeds-rancidity-causes-atmospheric oxidation and enzyme action-free fatty acids-Non edible oil Food and non food uses of oilseed cakes and meals; Glycerine; Lecithin and other products.
By-products of fat/oil processing industries – Oil seed protein isolates; Quality standards of fats and fatty foods; Antioxidantsand its mechanism of application.

Module V: (9L)
Changes during processing and storage of oils and fats, polymorphism, rancidity and reversion. Composition and properties of spoilage during storage of fats, and fat products, Lipid deterioration -Lypolysis, Factors affecting oxidation, Thermal oxidation of fats and oils, Photosensitised oxidation, Autoxidation; Role of lipids in food flavour, Protection against auto oxidation. Analysis of fats and oils -Composition and identity, Rancidity, hydrogenations, saponification, and iodine value of fats and oils. Tests for adulteration; Nutritional aspects- Fats and oils functionality, Palatability, Satiety; Lipids, Heart Healthy fats & oils : Information on health benefits, Omega-e polyunsaturated fatty acids. Edible fats and oils, identifications of natural fats and oils saturated and unsaturated fatty acids.

Text books:

1. Bailey's Industrial Oil and Fat Products, Vol 1 & 2; Swern D; 4th ed, 1982, John Wiley &SonsAdvances in food and nutrition research by Steve L. Taylor
2. The Chemistry & Technology of Edible Oils and Fats; Devine J & Williams PN; 1961, Pergamon Press.Food Chemistry by Belitz and Grosch, 2004
3. Food Oils and their Uses; Weiss TJ; 1983, AVI.
4. Edible Oils & Fats: Developments since 1978 (Food Technology Review # 57); Torrey S; 1983, NDC

Reference books:

1. Gillies, M.T. "Shortenings, Margarine and Food Oils". Noyes Data Corporation, 1974.
2. Paterson, Handling & Storage of Oilseeds, Oils, Fats & Meal, HBW.
3. S.C. Singhal, Modern Technology in the Oils & Fats industry, OTA
4. Weiss, T.J., "Foods, Oils and Other Uses". AVI Publishing Co, 1970.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	3	3	1	3	2	2	3	3	2	3	3	3
CO 2	3	2	3	2	2	3	3	3	2	3	2	2	3	3	3
CO 3	3	2	3	3	2	3	2	3	2	3	1	2	3	3	3
CO 4	3	2	3	3	2	3	3	3	2	3	1	2	3	3	3
CO 5	3	2	3	3	2	2	2	3	2	3	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 407**
Course title: **Advanced Food Chemistry and Microbiology Laboratory**
Pre-requisite(s): **Basics of Food Chemistry and Microbiology**
Co- requisite(s):
Credits: 3 L:0 T:00 P:06
Class schedule per week: **06**
Class: **IMSc**
Semester / Level: **VII/4**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students will:

1.	Recognize the important reactions in food chemistry and their consequences.
2.	Be familiar with methods to measure these reactions.
3.	Utilize laboratory techniques to detect, quantify, and identify microorganisms in foods.
4.	Acquire knowledge of, and apply the theories and principles of food microbiology in practical, real-world situations and problems.
5.	Develop success skills in communication, critical thinking, interaction, information acquisition and interpretation, organization, professionalism, leadership, auto-didactics and life-long-learning.

Course Outcomes

After the completion of this course, students will be:

CO1	Able to recognize the important reactions in food chemistry and their consequences.
CO2	Familiar with methods to measure food reactions.
CO3	Able to recognize specific types of microbial spoilage during various food shelf life stages.
CO4	Able to work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Able to clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Estimation of fat by soxhlet method
2. Analysis of rotein by micro-kjeldahl / spectrophotometric methods
3. Analysis of pectic substance
4. Analysis of Amylose/ Amylopectin ratio
5. Analysis of vitamin C/ B_2
6. Analysis of sugar by titrimetric (Lane & Eyonons/Anthrone/DNS) and spectrophotometric method
7. Analysis of volatile & non-volatile fatty acid in fat
8. polyphenol (Tannin) in food
9. Determination of enzyme activity of food
10. Determination color and pigments
11. Determination free fatty acid and iodine value of fat
12. Estimation of oxidative rancidity (Kries test / TBA test) & peroxide value
13. Nutritional requirements of microorganisms
14. Isolation and characterization of microbes based on morphological and physiological characteristics
15. Quality evaluation of water (Chemical, microbial, COD and BOD)
16. Quality control test of edible oil and fats.

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
8. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

13. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
14. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	2	2	1	2	1	3	3	3
CO2	3	3	3	2	3	3	3	2	2	1	2	1	3	3	3
CO3	3	2	3	2	3	3	2	2	2	1	2	1	3	3	3
CO4	3	3	3	3	3	3	3	2	2	1	2	1	3	3	3
CO5	2	3	3	3	2	3	3	2	2	1	2	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8

CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 409**
Course title: Advanced Food Processing Laboratory I
Pre-requisite(s):
Co- requisite(s):
Credits: 2 L:00 T:00 P:04
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VII/04**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students will be able to:

1.	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
2.	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
3.	Compare and contrast conventional and emerging food processing technologies in real-life food processing
4.	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Course Outcomes
After the completion of this course, students will be able to:

CO1	To describe food processing in terms of unit operations, both conceptually and in the pilot plant
CO2	To understand the use of mass and energy balances for food processing
CO3	To apply critical thinking skills to new food processing situations
CO4	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments

1. Production, quality control and Sensory Evaluation of biscuits
2. Production, quality control and Sensory Evaluation of cake
3. Production, quality control and Sensory Evaluation of bread
4. Production, quality control and Sensory Evaluation of confectionary products
5. Production, quality control and Sensory Evaluation of pasta
6. Studies on parboiling of rice
7. Studies on extruded cereal snacks
8. Production and quality control of cookies
9. Production, quality control and Sensory Evaluation of rice products (minimum three types)
10. Production, quality control and Sensory Evaluation of Fermented milk products(minimum five products-curd, cheese, acidophilus milk, yoghurt)
11. Production, quality control and Sensory Evaluation of fermented cereal product-beer, Dosa, Bread, Chakuli pitha
12. Production, quality control and Sensory Evaluation of fermented fruit product (white and red wine, Saurkraut, pickle)
13. Production, quality control and Sensory Evaluation of premixes (minimum three types)
14. Production, quality control of ethanol produced from molasses
15. Preparation and preservation of RTE foods.

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
9. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

15. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
16. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	2	3	3	3	3	2	2	3	3	3	3	3	3
CO2	3	2	2	2	2	3	3	2	2	3	3	3	3	3	3
CO3	2	2	2	3	3	3	3	2	3	3	3	2	3	3	3
CO4	2	2	2	3	3	3	3	2	2	3	3	3	3	3	3
CO5	2	3	2	3	2	3	3	2	3	3	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8

CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 410**
Course title: Novel Techniques in Food Processing and Packaging
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:03 T:01 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VIII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

A.	To provide the adequate knowledge on the Novel techniques in food Processing and Packaging
B.	To critically think about science behind different Novel techniques in food Processing and Packaging
C.	To utilize the technologies to solve problems in the food processing sectors.
D.	To understand novel food processing methods including non thermal food processing techniques.
E.	To develop an understanding of major packaging materials used in food packaging.

Course Outcomes

After the completion of this course, students will:

CO 1	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
CO 2	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
CO 3	Compare and contrast conventional and emerging food processing technologies in real-life food processing
CO 4	Review and critically appraise the recent literature on the quality of foods processed by advanced food processing technologies
CO 5	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Syllabus
FT 410 Novel Techniques in Food Processing& Packaging

Module I: [10L]
Theory, Process Parameters, Equipment, Effect on microorganism, enzyme, texture etc. Application in sterilization, Processing of Nonthermal Novel techniques : High Pressure Processing, Pulsed Electric Field, High Intensity Light, Irradiation, UV light, Pulsed Light, &Ultra sound, Pulsed X Ray, Oscillating magnetic field,. Food safety aspects, Diagnostics Ultrasound.

Module II: [8L]
Theory, Process Parameters, Equipment, Effect on microorganism, enzyme, teture etc. Application in sterilization, Processing of Thermal Novel techniques: Microwave, Radiofrequency, Infrared, Induction, Ohmic, Sous- vide Processing

Module III: [10L]
Membrane Separation techniques; Theory, Equipment - Membrane materials and modules, Process materials and application in Food Processing : RO, UF, Microfiltration membrane distillation,
Advances in Drying: Theory, effect of process parameters on mass transfer, quipment, application of Osmotic dehydration. Hybrid drying technologies: combined microwave vacuum drying, combining microwave vacuum drying with other processesetc. Freeze Drying.Supercritical fluid extraction,

Module IV: [9L]
Extrusion in food product development; Components and functions of an extruder; Classification of extruder; Advantages and disadvantages of different types of extrusion; Change of functional properties of food components during extrusion; Pre and post extrusion treatments; Use of extruder as bioreactor; Manufacturing process of extruded products; Application of extrusion technologies in food industries. Concept of Food Rheology and Measurement techniques, Viscoelasticity of foods
Module V: [9L]
Current use of novel packaging techniques, Types of packaging and packaging materials. Transport, optical and mechanical properties of packaging materials; Oxygen, ethylene and other scavengers, Oxygen scavenging technology, Ethylene scavenging technology, Carbon dioxide and other scavengers, Antimicrobial food packaging. Advanced Modified Atmosphere packaging MAP, Nanotechnology: Principles and applications in food Technology.

Text books:

1. Sun, D. Emerging Technologies for Food Processing, (Academic Press, 2005)(T1)
2. Barbosa-Canovas, G. V., Tapia, M. S. and Cano, M. P. Novel Food Processing Technologies, (CRC Press, 2004) (T2)
3. **Food Processing Technology, Principles and Practice, P. Fellows, CRC Press.(T3)**
4. R. Paul Singh. Introduction to Food Engineering,, , Dennis R. Heldman, Academic Press, 2009.**(T4)**

5. Food Process Engineering and Technology, **Zeki Berk, Academic Press.(T5)**

Reference books:

1. Ohlsson, T. and Bengtsson, N. Minimal Processing technologies in the food industry, (Woodhead Publishing Limited, 2002). (R1)

Gaps in the syllabus (to meet Industry/Profession requirements)

Fluid flow and mechanical operations machineries used in food sector

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Fluid flow and mechanical operations machineries used in food sector

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	3	3	3	1	3	3	2	2	3	3	3	3	3
CO 2	3	1	3	3	3	1	3	3	2	2	3	3	3	3	3
CO 3	3	1	3	3	3	1	3	3	2	2	3	3	3	3	3
CO 4	3	1	3	3	3	1	3	3	2	2	3	3	3	3	3
CO 5	3	1	3	3	3	1	3	3	2	2	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 411**
Course title: **Food Product Development and Consumer Science**
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:03 T:01 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VIII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

A.	To gather the adequate knowledge of Evaluating a planned and implemented food science experiment in the development of a nutritionally-altered food product
B.	Develop a real new food product prototype and prepare a scientifically comprehensive description of this prototype
C.	To develop a marketing plan in the promotion of the designed food product.
D.	To apply food science knowledge to functions of ingredients in food.
E.	To apply sensory and objective methods of evaluation of food products.
F.	To interpret current research and statistics in the development of the designed food product.

Course Outcomes

After the completion of this course, students will:

CO 1	Be able to implement their knowledge for the evaluation of a planned and implemented food science experiment in the development of a nutritionally-altered food product
CO 2	Be able to successfully develop a marketing plan in the promotion of the designed food product.
CO 3	Development of professional oral presentation skills.
CO 4	Understand factors that affect viability and potential of new food products. Patent literature, competition, costs.
CO 5	Understand new products from consumer viewpoint.

Syllabus
FT 411 Food Product Development and Consumer Science

Module I: [9L]
Objectives of product development: Role of food in human nutrition, Social, cultural, psychological and economical considerations. Nutritional disorders, natural contaminants and health hazards associated with food product development. Types of food: Therapeutic, Engineered, Fabricated, organic foods, Nutraceutical and functional foods.

Module II: [9L]
New Food Products- Defining the Newness and Novelty of food products and their characteristics, Consumer trends and their impact on new product development. Product development processes *viz.* to conceive ideas, evaluation of ideas, developing ideas into products, test marketing and commercialization. Marketing strategies of new products ,Research methodologies and statistics commonly used. Forecasting of product opportunities-short term profitability, payback potential, long run profitability potential; Green & Brown field Projects.

Module III: [9L]
Organiztion of the Food Products Development Team, The roles and purpose of each member, Budgetary roles, Outsourcing of food development**;** Getting to know your customer- Past trends of consumerism, Product Monopoly, Market research, Defining your market as well as survival protocols for contingencies.

Module IV: [9L]
Development of the food product- Development and Assessment of food products; Ingredient selection and formulation; Packaging and nutritional labelling designs; Product development and testing-Quality control issues, Test market selection, Evaluation of the results, Presentation of results; Product management, Product life cycle.-Introduction, growth, maturity and decline stages. Promotion and Distribution; Reasons for food products being successful in the market. Food product planning-Modifying the product, modifying the market, product Monopoly and repositioning of the product.

Module V: [9L]
Product pricing-Revenue and Costs, Break-even analysis, Debt Equity Ratio, Debt Service Coverage Ratio, Profit and Sales Projection, Return on Investment & Capital (ROI& ROC, IRR) and business analysis. Branding, Licensing and Acquisition, Franchising. Product Warranty; Legal and Public Policy Issues-Law and product development, Food regulation and Environmental standards, Pilot and industrial plant establishment, assessment; Feasibility study; Processing equipment selection; Quality and Cost Based Selection; Plant layout, equipment and installation.; Optimization of production operations; Forecasting future trends in the food product developed.

Text books:
1. Fuller, G.W. (2011). New food product development: From concept to marketplace. 3rd ed. New York, NY: CRC Press.

Reference books:

1. Berkowitz, E. N; Kerin, Roger, and Rudelius William (1989) Marketing, Homewood, IL, USA..

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus
Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design
Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	3	3	1	3	1	2	1	1	1	3	3	3	3
CO 2	3	2	3	3	2	3	1	2	2	1	1	3	3	3	3
CO 3	3	3	3	2	1	3	1	2	1	2	1	3	3	3	3
CO 4	3	3	3	3	1	3	1	2	2	1	1	3	3	3	3
CO 5	3	2	3	3	1	3	1	2	1	1	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 414**
Course title: **Advanced Food Analysis Laboratory I**
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L:00 T:00 P:06
Class schedule per week: **06**
Class: **IMSc**
Semester / Level: **VIII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

Course Objectives

This course enables the students will be able to:

1.	Demonstrate deep understanding food analysis and knowledge of principles of analytical technologies
2.	Identify and critically analyse the compositional properties of food
3.	Apply selected analytical methods to find out the functional characteristics of foods
4.	Compare and contrast conventional and emerging technologies in food analysis
5.	Acquire understanding behind the scientific basis of food analysis

Course Outcomes
After the completion of this course, students will be able to:

CO1	To describe importance and principles of analytical technologies for food
CO2	To understand the use of analytical methods and techniques for food analysis
CO3	To apply critical thinking skills to new protocols
CO4	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments

1 Qualitative estimation of Iron in wheat flour

2 Quantitative estimation of soluble Iron in wheat flour

3 Quantitative estimation of total Iron in wheat flour by spectrophotometer

4 Quantitative estimation of Iron by Atomic Absorption spectrophotometer

5 Detection of carbon dioxide in human breathing by Gas Chromatography

6 Determination of vitamin D

7 Determination of thiamin (B1)

8 Determination of niacin (B3)

9 Determination of folic acid (B9)

10 Determination of vitamin C

11 Determination of calcium in egg cell by EDTA

12 Separation of plant pigments by Thin Layer Chromatography (TLC)

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
10. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

17. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
18. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	2	2	1	2	1	3	3	3
CO2	3	2	3	3	3	3	3	2	2	2	2	2	3	3	3
CO3	3	3	3	2	3	3	3	2	2	1	2	1	3	3	3
CO4	3	3	3	3	3	2	3	2	2	2	2	1	3	3	3
CO5	3	2	3	3	3	3	3	2	2	1	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8

CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 415**
Course title: **Advanced Food Processing Laboratory II**
Pre-requisite(s):
Co- requisite(s):
Credits: 2 L:02 T:00 P:04
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **VIII/04**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students will be able to:

1.	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
2.	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
3.	Compare and contrast conventional and emerging food processing technologies in real-life food processing
4.	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Course Outcomes

After the completion of this course, students will be capable of:

CO1	To describe food processing in terms of unit operations, both conceptually and in the pilot plant
CO2	To understand the use of mass and energy balances for food processing
CO3	To apply critical thinking skills to new food processing situations
CO4	Work cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Pasteurization of milk
2. Preparation and Sensory Evaluation of Khoa
3. Preparation and Sensory Evaluation of Table Cream
4. Preparation and Sensory Evaluation of Chhana
5. Preparation and Sensory Evaluation of Paneer
6. Preparation and Sensory Evaluation of Ghee
7. Preparation and Sensory Evaluation of Creamery and Table Butter
8. Preparation and Sensory Evaluation of Chakka and Shrikhand
9. Preparation and Sensory Evaluation of Sweetened Condensed Milk (SCM)
10. Preparation of milk powder using spray drying
11. Preparation of Acid Casein and Rennet Casein
12. Bottling of Puff ball (Rugra)
13. Preparation of dehydrated products from Mushrooms
14. Preparation of salad dressing, mayonnaise and peanut butter
15. Preparation of Papar

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
11. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

19. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
20. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	3	3	3	3	3	3	2	2	1	2	1	3	3	3
CO2	3	3	3	3	3	3	3	2	2	1	2	2	3	3	3
CO3	3	3	3	3	3	3	3	2	2	1	2	1	3	3	3
CO4	2	3	2	1	2	3	2	3	2	3	1	2	3	3	3
CO5	2	3	1	2	1	3	2	3	2	3	1	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		

CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 501**
Course title: Flavour Chemistry and Technology
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:03 T:01 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IX/05**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

A.	To understand mechanisms of flavor perception
B.	To include the use of analytical chemistry to identify flavor compounds.
C.	To familiar with analytical methods of flavor analysis
D.	To understand mechanisms of flavor formation
E.	To apply sensory and objective methods of evaluation of food products.
F.	To recognize off-flavor defects in foods and strategies of identification..

Course Outcomes

After the completion of this course, students will:

CO1	Be able to identify the role of flavour molecules in food, from both a sensory and food quality perspective
CO2	Be able to identify the chemical structures of flavour compounds, and how those chemicals are produced from a synthetic or biological perspective.
CO3	Be able to describe manufacturing procedures used to produce the common food flavoring materials
CO4	Be able to understand mechanisms of flavor release
CO5	Be familiar with analytical methods of policing flavor adulteration

Syllabus
FT 501 Flavour Chemistry and Technology

Module I: (9L)
Food flavor and its importance to consumers and food processors. Non-enzymatic methods of flavor formation, Lipid Oxidation methods of flavor formation; Enzymatic methods of flavor formation. Objectionable flavor in foods and methods of detection; Flavor and nutrition. Sources, extraction, delivery systems, and analyses (chemical, instrumental, and sensory) off flavors and flavorings in foods.Flavour composition of foods/beverages (identification and quantitative analysis of the flavour precursors and their products, characterization of the staling reaction using stable isotopes). Analysis of odour-active compounds of food/beverages (Charm analysis).

Module II: (9L)
Sensory perception of flavor: Senses of taste and smell, tasting versus sniffing, astringency, pungency, interaction of senses in flavor perception; taste, odor, and acceptance of flavor stimuli. Flavour enhancers, flavour potentiators or modifiers. Methodology of sensory evaluation and determination of threshold levels as specified by BIS.

Module III: (9L)
Mechanism of flavor-food interactions, Flavor release on flavor perception ; Flavoring Materials, Flavoring constituents of various foods like meat, fish, milk, vegetables, fruits, fats & oils ,spices & herbs, cereals and pulses. Flavour composition of foods/beverages in relation with maturation and microbial activity/or the processing conditions (e.g. fermented dairy products, beer, wine, honey, fruits). Monitoring Adulteration of Flavors ;
Flavor changes during preservation, packaging, and storage of foods. Roles as sulfur compounds, fatty acids, amino acids, terpenoids, lactic acid-ethanol in food flavors. Process and reaction flavors/volatiles in foods.

Module IV: (9L)
Spices and herbs as food flavorings: Processing of basil, mint, saffron, cloves, tamarind, ginger, cardamom, chilies, pepper etc. for essential oils, extracts and oleoresins as the case maybe.
Determination of hygroscopic nature and shelf life/acceptance of foods. Natural, Nature identical and Synthetic flavors: Definitions, chemical composition/constituents, extraction and preparation of flavors, Stability and utility of flavor preparations.
Methods used in flavor evaluation. BIS Specifications/PFA restrictions for use of certain constituents in flavoring materials.

Module V: (9L)
Synthesis of flavour by microorganisms and plant cells. Lipid derived flavours. Investigation of equilibrium of key flavour compounds that govern the flavour stability of beverages. Natural antioxidant constraints in spices. Role of microorganisms in flavour development. Flavor emulsions, flavour composites, essential oils and oleoresins.

Text books:

1. Food Chemistry by Fennema, Marcel Dekker.
2. Spices &Flavor Technology by Pruthi, J.s.

3. Ashurst PR. 1994. Food Flavorings. 2nd Ed. Blackie.
4. Burdock GA. 2004. Fenaroli's Handbook of Flavor Ingredients.5th Ed.CRC Press.

Reference books:

1. Deibler D &Delwiche J. 2004. Handbook of Flavor, Characterization:
2. Sensory Analysis, Chemistry and Physiology. Marcel Dekker.
3. Heath HB &Reineccius G.1986. Flavor Chemistry and Technology. AVI Publ.
4. Taylor A. 2002. Food Flavour Technology. Sheffield Academic Press.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	1	2	3	3	2	3	2	2	3	1	1	3	3	3
CO 2	3	1	2	3	3	2	3	2	2	3	1	1	3	3	3
CO 3	3	1	2	3	3	2	3	2	2	3	1	1	3	3	3
CO 4	3	1	2	3	3	2	3	2	2	3	1	1	3	3	3
CO 5	3	1	2	3	3	2	3	2	2	3	1	1	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 502**
Course title: Food Processing Plant Design and Layout
Pre-requisite(s):
Co- requisite(s):
Credits:4 L:03 T:01 P:00
Class schedule per week: **04**
Class **IMSc**
Semester / Level: **IX/05**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

A.	To impart the basic principles and knowledge about the food plant layout and design, selection of location and machineries
B.	To educate the students regarding selection parameters for the location of food processing industry.
C.	To enable the students to design layout of various types of food processing industries.

Course Outcomes

After the completion of this course, students will:

CO1	To acquaint the students with various aspects of design and layout of food plant.
CO2	Be able to design layout of various types of food processing industries.
CO3	Be able to design the process flow sheet
CO4	Be aware about the selection parameters for the location, machineries, raw materialsfor food processing industry.
CO5	Be able to prepare a detailed project report for food industry.

Syllabus
FT 502Food Processing Plant Design & Layout

Module I: (9L)
Introduction to plant design - special features of food processing industry, plant location, location factors,site selection, layout - understanding of equipment layout ventilation, Layout objectives , classical and practical layout ; Reference to bakery and biscuit, fruits, vegetable and beverage processing, and dairy industries; Miscellaneous aspects of plant layout and design like provision for waste disposal, and safety arrangements; Characteristics of an efficient layout

Module II: (9L)
Design consideration for location of food plants, location theory and models; ISO, FPO, MPO requirements in food plant layout and design; Preparation of flow sheets for material movement and utility consumption in food plants; Plant location factors-plant site selection-estimation of series- peak and critical load-Economic plant size.

Module III: (9L)
Development and presentation of the layout, selection of site and Location of plant, General points of considerations for designing food plant,floor plant types of layouts Food building planning, -preparation of machinery layout for fruit, vegetables and meat-size reduction machinery layout; Layout and designing aspects of pilot and semi-commercial food processing plants; Scale-up; Application of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) in project planning and monitoring

Module IV: (9L)
Symbols used for food plant design and layout ;Food processing enterprise; Engineering economics; Process schedule; Plant operation; Evaporation plant layout-single, multiple, vacuum and film evaporators-types and concepts, drying plant layout, drying process, drier types, selection of driers.

Module V: (9L)
Baking oven and frying plant-types, concepts and layout. Filling closing and labeling plant layout.Organization and trends in plant layout - sample layout, installation procedure for food processing plant.

Text books:

1. James, M.More, “Plant Layout and Design”. MacMillian Publishing Co., New York 1976
2. Slade, F.H, “Food processing plant”. Leonardhill Books, London1967.

Reference books:

3. American Society of Heating, “Refrigerating and Air-Conditioning Engineers”, Ashrae Handbook, Fundamentals. ASHRAE, Atlanta, Georgia 1981.
4. Hall,H.S and Y.Rosen, “Milk plant layout” (F.A.O. Publication) 1976.

Gaps in the syllabus (to meet Industry/Profession requirements)

Fluid flow and mechanical operations machineries used in food sector

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Fluid flow and mechanical operations machineries used in food sector

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2	3	2	2	2	2	3	2	3	2	3	3	3	3
CO 2	2	2	3	2	2	2	2	3	2	3	2	3	3	3	3
CO 3	2	2	3	2	2	2	2	3	3	3	2	3	3	3	3
CO 4	2	2	3	2	2	2	2	3	2	3	2	3	3	3	3
CO 5	2	2	3	2	2	2	2	3	2	3	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8

CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 503**
Course title: Applied Statistics for Food Technology
Pre-requisite(s):
Co- requisite(s):
Credits: 4 L:03 T:01 P:00
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IX/05**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

A.	To understand statistics application in Food.
B.	To Understand the philosophy and basic concepts of quality improvement.
C.	To gather knowledge on food quality system and statistical quality control
D.	To demonstrate the ability to use the methods of statistical process control.
F.	To develop the skills on statistical methods and to understand data analysis for writing up a dissertation/ thesis/research article

Course Outcomes

After the completion of this course, students will:

CO 1	Be able to interpretive data from statistical point of view.
CO 2	Be able to identify and apply appropriate research methods and techniques to design, plan and execute targeted experiments or simulations independently and critically evaluate and interpret the collected data.
CO 3	Be able to apply statistical principles to food science applications.
CO 4	Students will have a thorough understanding of the arrangement of data to draw an analytical conclusion.
CO 5	Can convincingly and professionally defend personal research, thoughts, ideas, and opinions of proposals, both written and oral, to different actors and stakeholders from peers to a general public.

Syllabus

FT 503 Applied Statistics for Food Technology

Module I: (9L)

Food Quality System- Scope, Systems and programs for food quality- The Formalized Quality System, Quality System Guidelines, Malcolm Baldridge National Quality Award, Total Quality Management, Team Quality Systems, Computer Network Quality Systems Food safety, System for food safety; HACCP, ISO-22000.

Module II: (9L)

Analysis of Data , Frequency distribution, Normal, Binomial, Poisson, Geometric ,Exponential distribution, The t-Test, Chi-square test, F-test, ANOVA (Analysis of variance), Regression, Pearson square test, Standard error, Root mean square error (RMSE),Sum of square error (SSE)

Module III: (9L)

Statistical quality control-Quality control techniques, Sampling-Sampling plan, How to Take Samples , Types of Samples , Sampling plan for prepackaged foods FAO/WHO, Codex alimentarius procedure, Coefficient of correlation, Partial correlation, Regression analysis,

Module IV: (9L)

Statistical basics: -Mean median mode, Standard deviation, Degree of freedom, Degree of variance, Coefficient of variance, Null hypothesis; Vendor Quality Assurance- Vendor-Vendee Relations, Specifications for Raw Materials, Ingredients, Supplies, Quality Assurance of Purchased Goods, Selecting and Nurturing a Supplier, Packaging Supplier Quality Assurance, Supplier Certification Programs

Module V: (9L)

Process Capability- Capability Index, Benchmarking;Process Control- Chart Patterns, Control Chart as a Quality Management; Concept of six sigma; Sensory Testing- The Senses, Sensory Testing Methods, Types of Panels, Selection and Training.

Text books:

2. Hubbard, Merton R., Statistical Quality Control for the Food Industry, Springer US
3. Montgomery, Douglas C. (2009). Introduction to Statistical Quality Control, Sixth Edition. John Wiley and Sons, Inc. (ISBN: 978-0-470-16992-6).
1. Food quality assurance by Rangana,1995.

Reference books:

1. Statistical methods by S.P.Gupta ,2006

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design
POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	3	1	2	2	3	2	1	1	3	3	3	3
CO 2	3	3	2	3	1	2	2	3	2	1	2	3	3	3	3
CO 3	3	3	2	3	1	2	2	3	2	2	2	3	3	3	3
CO 4	3	3	2	3	2	2	2	3	2	1	1	3	3	3	3
CO 5	3	3	2	3	1	2	2	3	2	1	2	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8

CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 504**
Course title: Advanced Food Analysis Lab II
Pre-requisite(s):
Co- requisite(s):
Credits: 2 L:00 T:00 P:04
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IX/05**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students will be able to:

1.	Demonstrate deep understanding food analysis and knowledge of principles of colorimeter
2.	Identify and critically analyse the compositional properties of food by use of acid-base titrations
3.	Apply selected analytical methods (AAS) to find out the ion concentration of foods
4.	Compare and find out the suitable technologies (Textural or Rheological) for food samples
5.	Identify and critically analyse the thermal properties of food

Course Outcomes
After the completion of this course, students will be able to:

CO1	To describe importance and principles of analytical technologies for food
CO2	To understand the use of analytical methods and techniques for food analysis
CO3	To apply critical thinking skills to new protocols
CO4	Integrate cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly communicate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Determination of concentration of metal ion by colorimeter
2. **C**onductometric titration of acid/base, precipitation and metal ion complex
3. Acid base titrations by pH meter
4. Kinetic study of mutarotation of glucose by polarimeter
5. Determination of metal ion concentration by Atomic absorption spectroscopy
6. Microwave digestion of food sample and determination of metal ion concentration by ICP-OES
7. Texture Analysis of Food sample
8. Rheology of CMC solution by Brookfield viscometer
9. Differential Scanning Calorimetry
10. Thermogravimetric analysis
11. Ion Chromatography analysis of digested food sample

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
12. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

21. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
22. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment

(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	1	3	3	3	2	3	2	2	1	2	2	3	3	3
CO2	3	1	3	3	3	2	3	2	2	1	2	2	3	3	3
CO3	3	1	3	3	3	2	3	2	2	1	2	2	3	3	3
CO4	3	3	3	3	3	2	3	2	2	3	2	2	3	3	3
CO5	3	3	3	3	3	2	3	2	2	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 505**
Course title: Advanced Food Product Development Laboratory
Pre-requisite(s):
Co- requisite(s):
Credits: 2 L:00 T:00 P:04
Class schedule per week: **04**
Class: **IMSc**
Semester / Level: **IX/05**
Branch: **Food Technology**
Name of Teacher:
Course Objectives

This course enables the students:

1.	Demonstrate deep understanding and knowledge of principles of advanced food processing technologies
2.	Identify and critically analyse main advantages and disadvantages of emerging food processing technologies
3.	Compare and contrast conventional and emerging food processing technologies in real-life food processing
4.	Apply selected novel processing technologies to preserve and improve microbiological, nutritional or functional characteristics of foods

Course Outcomes

After the completion of this course, students will be:

CO1	To describe food Processing in terms of unit operations, both conceptually and in the pilot plant
CO2	To understand the use of mass and energy balances for food processing
CO3	To apply critical thinking skills to new food processing situations
CO4	Integrate cooperatively in a team to identify a food chemistry problem, design and conduct the experiments, and analyze and interpret the data.
CO5	Clearly illustrate research results using appropriate written, oral, and visual communication techniques.

List of experiments:

1. Formulation and preparation of cereal and fruit based drinks(RTS)
2. Preparation of ready to heat and eat products
3. Production and preservation of herbal beverages
4. Formulation and preparation of ice cream mix
5. Production of butter from milk and its quality control
6. Formulation, preparation and standardization of ready to cook spices/pastes
7. Development of flavoured vinegar
8. Preparation and preservation of mayonnaise
9. Development of soup powders and quality testing
10. Formulation and preparation of bakery items
11. Texturization of fruits and vegetables during processing
12. Preparation of synthetic/flavoured soft drinks
13. Production of starch powder from potato
14. Production of whole potato powder

Text books:

1. Food analysis - S.S. Neilson, Aspen publishers. Gaithery Berg Maryland
2.AOAC methods for Food Analysis.
3. Food Analysis, Theory and practice - Y. Pomeranz and C. EMeloan, A VI publishing company, INC West Port, Connecticut,USA.
4. Fung, D.Y.C. and Matthews, R. (1991): Instrumental Methodsfor Quality Assurance in Foods, Marcel Dekker, Inc. New York
5. Fruit and vegetable processing by Mircea EnachescuDauthy Consultant FAO Agricultural services bulletin No.119 Food and Agriculture Organization of the United Nations Rome, 1995
13. Preservation of Fruits & Vegetables by Girdhari Lal, Sidhapa and Tandon

Reference books:

23. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip,Handbook of Vegetable
24. Preservation and Processing, MarcelDekker,2003

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment

(1) Progressive Evaluation	60
Day-to-day performance	(10)
Lab files	(20)
Attendance	(10)
Viva	(20)
(2) End Semester	40
Quiz	(10)
Lab Performance	(30)

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO1	3	2	3	3	3	2	3	2	2	1	2	2	3	3	3
CO2	3	1	3	3	3	2	3	2	2	2	2	2	3	3	3
CO3	3	2	3	3	3	2	3	2	2	1	2	2	3	3	3
CO4	3	2	3	3	3	2	3	2	2	1	2	2	3	3	3
CO5	3	2	3	3	3	2	3	2	2	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD4, CD5, CD7, CD8
CD2	Tutorials/Assignments	CO2	CD4, CD5, CD7, CD8
CD3	Seminars	CO3	CD4, CD5, CD7, CD8
CD4	Mini projects/Projects	CO4	CD4, CD5, CD7, CD8
CD5	Laboratory experiments/teaching aids	CO5	CD4, CD5, CD7, CD8
CD6	Industrial/guest lectures		
CD7	Industrial visits/in-plant training		
CD8	Self- learning such as use of NPTEL materials and internets		
CD9	Simulation		

ELECTIVE COURSES

Elective III		**Elective IV**	
FT420	Principles of Food Processing and Preservation – compulsory for MSc lateral entry Students	FT423	Food Processing Technology- compulsory for MSc lateral entry students)
FT421	Automation in Food Processing Industry	FT424	Post Harvest Engineering
FT422	Enzymes in Food Processing	FT425	Food Supply Chain management

Elective V		**Elective VI**	
FT511	Computer Application in Food Industry	FT514	Nutraceutical & Functional Foods
FT512	Food Biotechnology	FT515	Food Processing Equipment Design
FT513	Grain storage technology	FT516	Agricultural and Rural Economics

COURSE INFORMATION SHEET

Course code: **FT 420**
Course title: **Principles of Food Processing and Preservation**
Pre-requisite(s): **Basic Knowledge of Microbiology**
Co- requisite(s):
Credits: 3 **L: 03 T: 00 P: 00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/04**
Branch: **Food Technology**
Name of Teacher:

Course Objectives Compulsory for MSc Lateral entry Students

This course enables the students:

1.	To develop knowledge of preserving food to prevent wastages and losses
2.	To make use of information on the scientific mechanism of food preservation
3.	To build practical knowledge to various methods of food processing.
4.	To apply variety in the diet by providing a range of attractive flavors, colors, aromas and textures in food (collectively known as eating quality, sensory characteristics or organoleptic quality)

Course Outcomes

After the completion of this course, students will be:

CO1	Able to justify the need for food processing
CO2	Able to illustrate the various processing techniques
CO3	Able to understand the various methods by which foods could be preserved
CO4	Able to discuss on the methods to extend the shelf life to allow time for distribution, sales and home storage.
CO5	Able to measure the shelf life of the food

Syllabus

FT420 Principles of Food Processing and Preservation

Module I : (9L)
Introduction to food processing: Basic principles, importance of food processing and preservation, classification of foods, food spoilage, viz. microbiological, enzymatic, chemical and physical spoilages and their effects on food quality. Objectives and techniques of preservation by use of high and low temperature, chemicals etc.

Module II : (9L)
Water activity (a_w) in foods: Role of water activity in preservation, control of a_w by addition of solutes and moisture removal, Intermediate moisture food (IMF), Principles, techniques of preservation. Processing by Moisture Removal: Evaporation, Concentration and Drying/ Dehydration, Drying of solid and liquid foods, Types of dryers, their advantages and disadvantages, Concentration of liquid food by different types of evaporators, Principles of freeze concentration, Membrane processes for liquid food concentration.

Module III : (9L)
High temperature processing: Principles of thermal processing, Blanching, Pasteurization and Sterilization, microbial destruction in batch and continuous sterilization, Heat resistance of micro-organisms, factors affecting heat resistance of micro-organisms, TDT curve, canning of foods, categories of foods for canning, heat penetration into food containers, calculating the process time for canned food, UHT processing, Microwave and radio frequency processing of foods.

Module IV : (9L)
Low temperature processing: Low temperature required for different foods, Refrigeration, chilling and Freezing of food, freezing principles, low and fast freezing, freezing process, determining freezing load, ammonia refrigeration systems, freezing rate, estimation of freezing time of foods, Types of freezers, thawing of frozen food. Freezing damage-osmotic damage Refrigeration Controlled Atmosphere Storage (CAS), Modified Atmosphere Storage (MAS).

Module V : (9L)
Food Preservation by Irradiation: Introduction, units of radiation, kinds of ionizing radiations used in food irradiation, mechanism of action, uses of radiation processing in food industry, concept of cold sterilization. Preservation by fermentation - Principles, Types of fermentation. Preservation by use of natural and chemical preservatives.

Text books:

7. Norman, N.P. and Joseph, H.H. (1997). Food Science. Fifth edition, CBS Publication, New Delhi.
8. Frazier, W.C. and Westhoff, D.C. (1996). Food Microbiology, 4th edn, Tata McGraw Hill Pvt. Ltd., New Delhi.
9. Fellows, P.J. (2002). Food Processing Technology : Principles and Practice, 2nd edn,

Woohead Pub. Ltd. .
10. M. Shafeiur Rahman (1999). Handbook of Food Preservation, Marcel Dekker, Inc.
11. Vickie A. Valdavik and Elizabeth, W. Christian (2003). Essentials of Food Science. Springers.

Reference books:

6. Food storage and preservation Vijayakhader
7. Food science B. Srilakshmi
8. Food preservation Desrosier
9. Physical principles of food preservation Fennema

Gaps in the syllabus (to meet Industry/Profession requirements)

Industrial visit and designing of operational flow diagram of respective food industry

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Recent advances in non thermal preservation techniques

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	3	3	3	2	3	2	3	2	3	2	3	3	3
CO 2	3	2	3	3	3	2	3	2	3	2	3	2	3	3	3
CO 3	3	3	3	3	3	2	3	2	3	3	3	2	3	3	3
CO 4	3	2	3	3	3	2	3	2	3	2	3	2	3	3	3
CO 5	3	2	3	3	3	3	3	2	3	2	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 421**
Course title: **Automation in Food Processing Industry**
Pre-requisite(s):
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/4**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To develop knowledge about applications of digital devices and control system in food industry
2.	To build up knowledge on the scientific data processing, dynamic data analysis, image processing
3.	To build practical knowledge of automation in different units of food processing.
4.	To provide information regarding application of automation in food processing industry
5.	To build practical knowledge of different feedback systems

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to justify with the need and applications of digital devices and control system for processing of food
CO 2	Able to develop plant layout, control system- Feedback and feed forward control strategies, block diagrams etc. for the processing of different food material
CO 3	Able to understand the various methods by which control system for food analysis can be designed
CO 4	Able to use the thermal plant automation, dehydration and freezing pant automation to extend the shelf life of food.
CO 5	Able to demonstrate the automation principles automation in food analysis.

Syllabus
FT421- Automation in Food Processing Industry

Module I : (9L)
Measurement system and error analysis, measurement of level, flow, temperature, strain pressure, vacuum, force, torque, power, displacement, vibration, acceleration, pH, colour viscosity, surface tension and composition. Indicating recording instruments, digital displays, transmitting and telemetering devices.

Module II : (9L)
Introduction to control system- Feedback and feed forward control strategies, block diagrams, Mode of control and generation of control action; P. PI and PID control
elements and value positioners, Electronic, pneumatic and hydraulic control systems and their application in farm machinery, food processing industry, aquaculture and their applications milk processing plants.

Module III: (9L)
Introduction: electronic nose, food quality evaluation, indication variables, Data acquisition, elastography, electronic nose, ultrasonic, Data analysis, intramuscular fat, wavelet, marbled meat, statistical textural feature extraction from, elastography, Sampling, concept and system for data acquisition, image acquisition, ultrasonic B- mode imaging. Data Analysis – Data processing, Dynamic data analysis, Image processing.

Module IV: (9L)
Modeling system identification, Modeling strategy, linear statistical modeling, ANN Modeling, F statistic, null hypothesis Prediction Levenberg-Marquardt algorithm, recurrent neural networks, gradient descent. Control objective function, neuro-fuzzy, membership functions Systems integration assembly language, high-level programming language.

Module V: (9L)
System integration, Robotics, Application of robotics and basic components of robotics, Features of II and II generation robots. Bottle Washing Machine Automaton, Bottling Plant Drive System, Demineralization Plant Control System, Labeling Machine Control system, Charger level automation, Reverse Osmosis plant automation, Thermal plant automation, Dehydration and freezing pant automation. Automation in different units of food processing, preparation of raw food and materials, sorting, grading, size reduction, mixing an agitation, thermal processing, dehydration, packaging, CIP, quality control.

Text Books:
1. Considine 2001. *Process Control*. AVI Publ.
2. Huang Y & Lacey RE. 2003. *Principles of Robotics*. CRC Press.
Reference Books:
3. Huang Y, Whittaker AD & Lacey RE. 2001. *Automation for FoodEngineering*. CRC Pr

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 2	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 3	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 4	3	2	2	3	3	2	3	2	3	3	2	2	3	3	3
CO 5	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 422**
Course title: **Enzymes in Food Processing**
Pre-requisite(s):
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/4**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand basic chemistry of enzymes related to food industry
2.	To explain Enzymes, their Classification, properties, characterization and uses in food.
3.	To provide vast information about the production of protein hydrolysates and bioactive peptides through Enzymes.
4.	To explain the application and role of enzymes in Dairy industry for cheese and whey processing.
5.	To demonstrate the applications and processing effects of enzymes in bakery, fruit & vegetable and meat processing.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to identify the suitable enzymes for food processing
CO 2	Able to develop desired properties in food material by using enzymes
CO 3	Able to understand the various methods by processing of fruit juices
CO 4	Able to use of enzyme-aided extraction of plant materials for production of flavors
CO 5	Able to explain about different food products from cereals by the applications of various enzymes

Syllabus
FT 422 Enzymes in Food Processing

Module - I: (9L)
Enzymes–classification, properties, characterization, kinetics, immobilization and production process. Fermentative production of important enzymes in food processing industries and their applications.

Module -II : (9L)
Enzymes for production of protein hydrolysates, maltodextrins and corn syrup solids (liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup), fructose and fructooligosaccharides.

Module - III : (9L)
Role of enzymes in food process like peeling, debittering, decolorization and production of food products like cheese, whey production and fruit juices.

Module –IV: (9L)
Role of enzymes in cereal processing like baking, beer/ wine production, meat and poultry processing industry.

Module –V: (9L)
Enzyme processing for flavor production, synthesis of bioactive peptides and tailor made fats.

Books:

1. Flickinger MC & Drew SW. 1999. *Encyclopedia of Bioprocess Technology*. A Wiley- Inter Science Publ.
2. Kruger JE *et al*. 1987. *Enzymes and their Role in Cereal Technology*. American Association of Cereal Chemists Inc.
3. Nagodawithana T & Reed G. 1993. *Enzymes in Food Processing*. Academic Press.
4. Tucker GA & Woods LFJ. 1991. *Enzymes in Food Processing*, Springer.S

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 2	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 3	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 4	3	2	2	3	3	2	3	2	3	3	2	2	3	3	3
CO 5	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 423**
Course title: **Food Processing Technology**
Pre-requisite(s):
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/3**
Branch: **Food Technology**
Name of Teacher:

Compulsory for Non Food

Course Objectives

This course enables the students:

1.	To illustrate the composition and processing technology of cereal, dairy, fruits and vegetables.
2.	To demonstrate the basic knowledge relating to the methods and principles of food processing and food Preservation.
3.	To summarize with the factors affecting food quality during processing and storage of food.
4.	To infer about the Canned food products from Fruits & vegetables.
5.	To discuss relating to the methods and principles of processing of Cereals & Pulses, milk and fruits and vegetables.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand the basic principles of food processing and preservation.
CO 2	Able to understand the role of different methods of preservation on different foods and their impact on the shelf life, quality, and other physical and sensory characteristics of foods.
CO 3	Able to use the recent methods of minimal processing of fruits and vegetables.
CO 4	Able to explain types of cereals, composition & nutritive value and processing of cereals and pulses
CO 5	Able to illustrate the processing methods of Cream, butter, margarine, spreads and cheeses, paneer, ghee, khoa and channa etc.

Syllabus

Module- I: (9L)

Introduction to food processing technology

Definition, scope and current trends in food processing, methods and principles of food processing and food preservation. General principles of food hygiene, relation to food reparation, personal hygiene. Principles of food quality assurance.

Module- II: (9L)

Cereals and Pulses

Composition and nutritive value, types of cereals, processing of cereals and pulses (gelatinization of starch and the factors affecting it, germination and fermentation), toxic constituents in pulses, milling of pulses.

Module- II: (9L)

Milk and milk products

Types of milk, Composition and nutritive value, Introduction to liquid milk technology (clarification, pasteurization, homogenization, fortification, sterilization). Effect of processing on milk, Introduction to milk products (Cream, butter, margarine, spreads and cheeses, panir, ghee, khoa and channa etc.).

Module- IV: (9L)

Fruits and vegetables

Classification of fruits and vegetables, composition and nutritive value, Post harvest changes in fruits and vegetables; Factors responsible for changes in colour, texture and flavour after harvest. Fruits and vegetables product processing: extraction, clarification, concentration and packaging of fruit juice, jam, jelly, marmalade, squash, candies, tomato products (sauce, ketchup, puree and paste).

Module- V: (9L)

Canning- The art of appertizing; categories of foods for canning; spoilage of canned foods, storage of canned foods; Influence of canning on the quality of food commodities.

Reference Books:

1. Potter N, Hotchkiss JH. Food Science. 5th edn. Delhi: CBS Publishers, 2007.
2. Fellows, P. (2004). Food processing Technology: Principles & Practices, 2nd edition, CRC Press USA.
3. Y. H. Hui, S. Ghazala, D.M. Graham, K.D. Murrell and W.K.Nip, Handbook of Vegetable Preservation and Processing, Marcel Dekker, 2003.
4. Girdhari Lal, Sidhapa and Tandon, Preservation of Fruits & Vegetables, ICAR, New Delhi

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 2	3	2	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 3	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3
CO 4	3	2	2	3	3	2	3	2	3	3	2	2	3	3	3
CO 5	3	3	2	3	3	2	3	2	3	2	2	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL		

	materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 424**
Course title: **Post Harvest Engineering**
Pre-requisite(s):
Co- requisite(s):
Credits: **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/4**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To familiarize students with agricultural produce and post harvest operations
2.	To impart students basic knowledge relating to storage, conditions for storage of perishable products and functional requirements of storage
3.	To familiarize students with the principles of drying and factors affecting drying, types of drying methods and factors drying.
4.	To pass on basic knowledge of Post Harvest Technologies related to Fruits and Vegetables
5.	Student will be made aware of the technological changes that are occurring in this field along with pre and post-harvest technology, physiology and biochemistry, cooling and storage systems, waste management, advances in processing, nutraceuticals and functional foods.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand the agro produce and their post harvest handling methos.
CO 2	Able to understand the role of storage and requirements of storage for extension of shelflife of different agro produce.
CO 3	Able to interpret with the recent methods of minimal processing of fruits and vegetables.
CO 4	Able to describe types of cereals, composition & nutritive value and storage condition of cereals and pulses.
CO 5	Able to describe Post harvest losses in agricultural and horticultural produces.

Syllabus
FT 424 Post Harvest Engineering

Module – I: (9L)
Introduction of post harvest technology
Introduction to post harvest technology of agricultural produce; Status of Production, Losses, Need, Scope and Importance, Introduction to various post harvest operations like Harvesting, Handling cleaning, grading, sorting, drying, storage, milling, size reduction, expelling, extraction, blending, heat treatment, separation, material handling (transportation, conveying, elevating),washing; their functions and use in the post harvest processing

Module –II: (9L)
Spoilage in storage
Types and causes of spoilage in storage, conditions for storage of perishable products, functional requirements of storage, control of temperature and relative humidities inside storage, calculation of refrigeration load; modified atmospheric storage and control of its Environment, air movement inside the storage,

Module - III : (9L)
Drying of Cereals and Pulses
Introduction, importance of drying, principles of drying and factors affecting drying, types of drying methods i.e. sun drying & artificial drying by mechanical means – Psychometric Chart, Moisture content representation, equilibrium moisture content, determination of moisture content by direct and indirect methods. Introduction to various grain drying systems.

Module –IV : (9L)
Storage of Cereals and Pulses
Introduction, need and importance, general principles of storage. Temperature and moisture changes during storage i.e. influence of moisture content, relative humidity, temperature, fungi etc. on stored product. Fungi, insect and other organism / Infections associated with stored grains. Types of storage structures.

Module - V: (9L)
Post Harvest Technology of Fruits and Vegetables
Methods of Harvesting and Post harvest losses in fruits and vegetables, Handling of Fruits and Vegetables. Introduction to the storage of fruits and vegetables. Need and importance of storage. Principle of storage of fruits and vegetables. Recommended storage operation conditions for some important fruits and vegetables and their storage life. Post harvest treatment to increase shelf life. Introduction to Packaging of fruits and vegetables and types of packaging. Concept of modified atmosphere packaging.

Text books:

1. Post Harvest Technology of Cereal, Pulses, Oil seeds A.Chakraverty Oxford & IBH Publication Co.
2. Unit operation of Agro Processing Engineering Dr.K.M. Sahay& K.K Singh Vikas Publications.

3. Post Harvest Technology of fruits & Vegetables Thompson CBS Publishers and Distributors
4. Post Harvest (Introduction Physiology Handling fruits & Vegetables) Wills R.B.H. Oxford & IBH Publication Co.

Reference books:

1. N Lewis, The Cold Chain, Hamish Hamilton (1988).

Gaps in the syllabus (to meet Industry/Profession requirements)

Fluid flow and mechanical operations machineries used in food sector

POs met through Gaps in the Syllabus

PO3, PO4, PO5

Topics beyond syllabus/Advanced topics/Design

Fluid flow and mechanical operations machineries used in food sector

POs met through Topics beyond syllabus/Advanced topics/Design

PO3, PO4, PO5

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO 2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	3
CO 3	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3
CO 4	2	2	2	3	3	3	2	3	3	3	3	3	3	3	3
CO 5	2	2	2	2	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 425**
Course title: **Food Supply Chain Management**
Pre-requisite(s): **FT204 Basics of Food Processing & Preservation**
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **VIII/4**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To make acquainted students with Supply Chain Management in Food Industry
2.	To impart basic knowledge of Supply Chain Process Cycles, Information and Communication Technology used in Supply Chain services in Logistical system
3.	To familiarize students with the Bar-coding, Dynamic pricing and Vendor Managed Inventory.
4.	To pass on basic knowledge of cold chain system, importance of cold chain components and retail chain system in food business
	To impart knowledge and competencies for designing supply chain strategies.

Course Outcomes

After the completion of this course, students will be:

CO 1	Able to understand the role of Supply Chain in Food Industry.
CO 2	Capable of associate with the Supply Chain in Food Industry
CO 3	Able to associate with the recent methods of minimal processing of fruits and vegetables.
CO 4	Capable of explaining the Bar-coding, dynamic pricing and inventory control in food Industry.
CO 5	Able to predict the losses during distribution and marketing of the food products.

Syllabus
FT 425 Food Supply Chain Management

Module 1: **Introduction to Supply Chain Management**
Concepts, Objectives, Information and Material flow in the Supply Chain, Supply Chain Planning, Supply Chain Decision Making, Benefits of Supply Chain Management in Industry

Module 2: **Dynamics of SCM**
Supply Chain Process Cycles, Supply Chain Integration, Bullwhip effect in Supply Chain, Information Systems and Processing in Supply Chain, Collaborative Planning Forecasting and eplenishment (CPFR), Inventory Planning and control. Information and Communication Technology used in Supply Chain Need and Role of an Information System in SCM, Enterprise Resource lanning (ERP), Concept of SAP in Supply chain, Current Trends of use of IT in SCM, Use of IT enabled technologies / services in Logistical system.

Module 3: Supply Chain Management Practices
Bar-coding, Tierization of suppliers, Vendor Managed Inventory, Hub and Spoke concept, Dynamic pricing, Third Party Logistics (3 PL's) providers, Fourth Party Logistics (4 PL's) providers, Reverse Logistics, Green Logistics, Cross docking.

Module 4: Cold chain in food processing
Introduction, scope, importance of cold chain components and retail chain system in food business, Products going in cold chain, their requirements (temperature and humidity etc.), packaging needs and their compatibility in cold chain. Documentation, recording of temperature and traceability.

Module 5: Stages and points of control
Stages and points of control in cold storages and structures, functions in cold storages, pallet layout and stacking options, flexibility storage systems cold chain transportation in land and export, retail & supermarket cold chain and display systems.

Books:

1. Systems. Prentice Hall.Chopra S & Meindel P. 2002. Supply Chain Management: Strategy, Planning and Operation. Prentice Hall.
2. Handfield RB &Nochols EL.1999. Introduction to Supply Chain Management. Prentice Hall.
3. Designing and Managing the supply Chain concepts, Strategies and Cases, Simchi - Levi, D.PKaminsky, Edith Simchi-Levi Tata McGraw – Hill.
4. Shapiro JF. 2001. Modeling the Supply Chain. Duxbury Thomson Learning.
5. Supply Chain Management - Test and Cases, Janat Shah, Pearson .

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO 2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	3
CO 3	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3
CO 4	2	2	2	3	3	3	2	3	3	3	3	3	3	3	3
CO 5	2	2	2	2	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8

CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 511**
Course title: **Computer Application in Food Industry**
Pre-requisite(s): **Basic knowledge in computer programming**
CS 102 Programming for Problem solving Laboratory
Co- requisite(s):
Credits: **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **IX/5**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students to have:

1.	Fundamental knowledge on hardware and software ofcomputers.
2.	Knowledge related to the applications of computers infood industries
3.	Information about the computerized machines and equipments in some common food industries
4.	Knowledge related to role of Computer in food process optimization and statistical quality control of final products

Course Outcomes

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

CO 1	Apply the suitable and useful hardware and software of computers
CO 2	Apply MS Excel, and other software used in Food Processing Industries.
CO 3	Design programmes in C++
CO 4	Apply commercial software for optimization and statistical Quality control
CO 5	Examine the processes and quality control of products during production

Syllabus
FT 511 Computer Application in Food Industry

Module I: (8L)
Fundamentals of Computer including Devices and Internet Overview of operating Systems:- Windows, LINUX, MS-Office, MS-Excel, MS-PPT, MS-SQL

Module II : [10L]
Application of MS Excel and C/C++ to solve the problems of Food Technology
Chemical kinetics in food processing: - b) Microbial distraction in thermal processing of food - Statistical quality control - d) Sensory evaluation of food - e) Mechanical transport of liquid food.

Module III: (9L)
Modelling and simulation of unit operation in Food processing Industry : Heat Exchager, multiple effect evaporators dryers etc.

Module IV: (9L)
Familiarization with the application of computer in some common food industries like, milk plant, bakery units & fruits vegetable plants, stating from the receiving of raw material up to the storage & dispatch of finished product

Module V: (9L)
Role of Computer in Optimization and statistical quality control Basic Introduction to computer aided Design and manufacturing.

'Books:

1. Computer Applications in Food Technology: Use of Spreadsheets in Graphical, Statistical and Process Analysis by R. Paul Singh, AP.
2. Solving Problems in Food Engineering by StavrosYanniotis, Springer
3. Manuals of MS Office

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	2	2	2	2	2	2	3	3	2	2	2	2	2	2
CO 2	2	3	2	2	3	2	2	3	3	2	2	2	2	2	2
CO 3	3	2	2	3	2	2	2	3	3	2	2	2	2	2	2
CO 4	2	2	2	2	2	2	2	3	3	2	2	3	2	2	2
CO 5	2	3	2	2	2	2	3	3	3	2	2	3	2	2	2

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
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CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code:	**FT 512**
Course title:	**Food BioTechnology**
Pre-requisite(s):	**FT 203 Food Microbiology** **FT204 Basics of Food Processing & Preservation**
Co- requisite(s):	**FT303 Meat, Fish and Poultry Product Technology**
Credits:	**L:03 T:00 P:00**
Class schedule per week:	**03**
Class:	**IMSc**
Semester / Level:	**IX/5**
Branch:	**Food Technology**
Name of Teacher:	

Course Objectives

This course enables the students:

1.	To explore the biotechnological applications relate to food.
2.	To provide knowhow about biotechnological food additives, biotechnological food diagnosis and regulations.
3.	To give students a comprehensive understanding of transgenic food
4.	To provide knowhow about the use biotechnological tools and their contribution to food production
5	Understand the principles and current practices of processing techniques and the effects of processing parameters on product quality.

Course Outcomes

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

CO 1	Understand the definitions of biotechnological terms and the different uses of food biotechnology.
CO 2	To apply biotechnological tools for production of recombinant proteins and additives in food industry
CO 3	Explain about transgenic foods, diagnostic system used in food industry and ethics and safety of food biotechnology.
CO 4	After the course the students are expected to describe new development in the field with analytical thinking of the various aspects of the new technology.
CO 5	Students will be able to determine the industrial problems related to food industries.

Syllabus

FT512 FOOD BIOTECHNOLOGY

Module -I (9 Hrs.)
Introduction to Food Biotechnology: basic principles of genetic engineering, improvement of the processing of various crops by genetic engineering, food safety.

Module -II (9 Hrs.)
Natural Antimicrobials for Food Preservation: Phytoalexins, essential oils and their components, bacteriocins of Lactic acid bacteria, nisin, pediocins etc, applications of bacetriocins in food systems. Aflatoxins - production, control and reduction using molecular strategy.

Module -III (9Hrs.)
Protein Engineering in Food Technology: Methods, applications of protein engineering (e.g. glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic nisin). Biotechnology and Food ingredients: biogums, fat substitutes, biocolors, organic acids and sweeteners.

Module -IV (9 Hrs.)
Food Biotechnology and Intellectual property rights (IPR), benefits of securing IPRs; bioethics in food biotechnology. Transgenic Plants and Animals: Their contribution to food production enhancement.

Module -V (9 Hrs.)
Bio-ethanol and bio-diesel technology: production of fuel ethanol by fermentation of sugars. Trans-Esterification of non-edible oils to produce bio-diesel.

Recommended Books

1. B.H. Lee, 'Fundamentals of Food Biotechnology', VCH Publishers, New York, U.S.A.
2. M.P. Tombs, 'Biotechnology in Food Industry', Wiley-Blackwell, U. K.
3. D. Knorr, 'Food Biotechnology', Marcel Dekker, INC, New York, U.S.A.
4. A. Schwartzberg and A Rao 'Biotechnology & Food Process Engineering' Marcel Dekker, INC, New York.
5. I. Goldberg and R. Williams, 'Biotechnology and Food Ingredients', Springer Science & Business Media, Germany.
6. R.D. King and P.S.J. Cheetham, 'Food Biotechnology', Elsevier Applied Science, London.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	2	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO 2	2	2	2	2	3	3	3	2	3	3	3	3	3	3	3
CO 3	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3
CO 4	2	2	2	3	3	3	2	3	3	3	3	3	3	3	3
CO 5	2	2	2	2	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8

CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 513**
Course title: **Grain Storage Technology**
Pre-requisite(s): **FT 424 Post Harvest Engineering**
Co- requisite(s): **FT204 Basics of Food Processing & Preservation**
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **IX/5**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To explore the knowledge of type and properties (Physico-chemical and thermal) of cereals grains and drying systems.
2.	To provide knowhow about storage conditions and changes (physical, chemical, microbiological and sensory) occurring during storage
3.	To give students a comprehensive understanding of Types of storage: structures and designs
4.	To provide knowhow about the application techniques of Insecticides, Rodenticides and Fumigants in warehouses
5.	To provide knowhow about the low cost design for rural use.

Course Outcomes

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

CO 1	Explain the cereals/grains and their properties like grain dimensions, bulk density, true density, porosity etc.
CO 2	To discuss drying methods and equipments for cereals/grains
CO 3	Demonstrate with storage structures and designs those are suitable for prevention of deterioration of cereals/grains
CO 4	After the course the students are expected to illustrate physical, chemical, microbiological and sensory qualities of cereals/grains
CO 5	Students will be able to reduce the deterioration of cereals/grains by use of Insecticides, Rodenticides and Fumigants in warehouses

Syllabus
FT 513 Grain Storage Technology

Module I : (9)
Physico-chemical and thermal properties of grains - grain dimensions, bulk density, true density, porosity, coefficient of friction, angle of repose, thermal conductivity and aerodynamic properties. Psychrometry: humidity, % relative humidity, humid heat, deterioration index, wet bulb temperature, use of psychrometric charts.

Module II : (9)
Grain drying - moisture content, equilibrium moisture content; free and bound water, rate of drying, constant and falling rate of drying rate; factors affecting rate of drying process, types of dryers used for drying of grains.

Module III: (9)
Grain storage – principles, moisture movement during bulk storage of grains, pressure distribution in storage bins, methods of aeration, various theories,

Module IV: (9)
Physical, chemical, microbiological and sensory changes occurring during storage, Grain storage structures - location and material selection for storage building, Types - traditional, modern; temporary and permanent storage structures; design considerations.

Module V: (9)
Insects and pests – types, extent of losses during storage, causes and control measures, Insecticides- principles, scope of application in warehouses; requirements, group of active ingredients, choice, toxicity, resistance, application techniques, Fumigants and Rodenticides.

Text Books

1. Chakraverty& De *Post Harvest Technology of Cereals, Pulse and Oilseeds*. IBH Publ.
2. Mahajan & Goswami. 2005. *Food and Process Engineering*.
3. Ojha TP & Michael AM. 2006. *Principles of Agricultural Engineering*. Jain Brothers

Reference Book:

1. AACC. 2004. *Storage of Cereal Grains and their Products*.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO 1	3	3	2	3	3	3	3	2	3	2	3	3	3	3	3
CO 2	3	2	3	2	3	3	3	2	3	3	3	3	3	3	3
CO 3	3	3	3	2	2	3	2	3	3	3	3	3	3	3	3
CO 4	2	3	2	3	3	3	2	3	3	3	3	3	3	3	3
CO 5	3	2	2	2	3	3	2	3	3	3	3	3	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8

CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 514**
Course title: **Nutraceuticals and Functional Food**
Pre-requisite(s):
Co- requisite(s):
Credits:3 **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **IX/5**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To explore the knowledge of Nutraceutical, regulatory issues for Nutraceuticals and CODEX.
2.	To provide knowhow about nutraceutical compounds and their mechanisms of action, dosage levels as per requirements (age and diseases)
3.	To give comprehensive understanding of formulation of functional foods and health foods
4.	To provide knowhow about the use of secondary metabolites in food products and preservation of Nutraceuticals
5.	To provide students with an overview of the field of functional foods, nutraceuticals and natural health products.

Course Outcomes

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

CO 1	Explain the Nutraceuticals and their compositional properties and mechanisms of action of nutritional components
CO 2	To determine and develop safe functional foods by use of secondary metabolites
CO 3	Associate with clinical testing of Nutraceuticals and health foods
CO 4	After the course the students are expected to explain the therapeutic importance of alkaloids, steroids ,isoflavones etc.
CO 5	Students will be able to restate the deterioration of Nutraceuticals through preservation techniques

Syllabus
FT514 Nutraceuticals & Functional Food

Module I: (9)
Introduction to Nutraceuticals: definitions, synonymous terms, basis of claims for a compound as a nutraceutical, regulatory issues for Nutraceuticals including CODEX.

ModuleII: (9)
Concept of angiogenesis and the role of Nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels, contraindications if any etc.

Module III: (9)
Manufacturing aspects of selected Nutraceuticals such as lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols etc.; formulation of functional foods containing Nutraceuticals – stability and analytical issues, labeling issues.

Module IV: (9)
Clinical testing of Nutraceuticals and health foods; interactions of prescription drugs and nutraceuticals; adverse effects and toxicity of nutraceuticals; nutrigenomics – an introduction and its relation to nutraceuticals.

ModuleV: (9)
Value addition in food products using secondary metabolites of therapeutic importance-alkaloids, steroids ,isoflavones etc. Nutraceuticals preservation. Evaluation and standardization. Toxicity in food products. Stability and evaluation of toxicity.

Suggested Readings

1. Brigelius-Flohé, J & Joost *HG. 2006. Nutritional* Genomics: Impact on Health and Disease. Wiley VCH.
2. Cupp J & Tracy TS. 2003. *Dietary Supplements: Toxicology and Clinical Pharmacology*. Humana Press.
3. Gibson GR & William CM. 2000. *Functional Foods - Concept to Product*
4. GoldbergI. 1994. *Functional Foods: Designer Foods, Pharma Foods*.
5. Losso JN. 2007. *Angi-angiogenic Functional and Medicinal Foods*. CRCPress.
6. Manson P.2001. Dietary Supplements. 2nd Ed. Pharmaceutical Press.
7. Campbell JE & Summers JL. 2004. *Dietary Supplement Labeling Compliance*.
8. Neeser JR & German BJ. 2004. *Bioprocesses and Biotechnology for Nutraceuticals.* Chapman & Hall.
9. Robert EC. 2006. *Handbook of Nutraceuticals and Functional Foods*. 2nd Ed. Wildman.
10. Shi J.(Ed) 2006. *Functional Food Ingredients and Nutraceuticals: Processing echnologies*.. CRC.
11. Webb GP. 2006. *Dietary Supplements and Functional Foods*. Blackwell Publ.

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10
Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
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CO 3	3	3	3	2	2	3	2	3	3	3	2	3	3	3	3
CO 4	2	2	3	3	3	3	2	3	3	3	2	2	3	3	3
CO 5	3	2	3	2	3	3	3	3	3	2	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
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CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code:	**FT 515**
Course title:	**Food Processing Equipment Design**
Pre-requisite(s):	
Co- requisite(s):	
Credits:	**L:03 T:00 P:00**
Class schedule per week:	**03**
Class:	**IMSc**
Semester / Level:	**IX/5**
Branch:	**Food Technology**
Name of Teacher:	

Course Objectives

This course enables the students:

1.	To acquaint and equip the students with the design features of different food processing equipments being used in the industries and with the layout, planning of different food and processing plants.
2.	To acquire basic understanding of design parameter, complete knowledge of design procedures for commonly used process equipment and their attachments
3.	To give comprehensive understanding of Performance characteristics f different food equipments
4.	To provide knowhow the design of storage vessels for liquid food and grains
5.	To acquire basic understanding of design parameter of heat exchanger and evaporators

Course Outcomes

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

CO 1	Illustrate the basics of process equipment design and important parameters of equipment design
CO 2	Outline the design of internal pressure vessels and external pressure vessels
CO 3	Ability to analyze Performance characteristics f different food equipments
CO 4	Describe different equipment fabrication and testing methods
CO 5	Ability to analyze design features of different food processing equipments being used in the industries and with the layout, planning of different food and processing plants.

Syllabus
FT515 Food Processing Equipment Design

Module I : Physical properties of food materials and energy balance calculations for preliminary estimation of plant capacity and equipment sizes. Preparation of flow sheets for material movement and utility consumption in food plant. Materials of construction : welding and machining of stainless steel. Fabrication of equipment.

Module II: Design of storage vessels for liquid food and grains. Pressure vessels design and design of vessel for drum drying.

Module III: Performance characteristics and selection of fans, blowers, ejector compressors and vacuum pumps. Design of fluid conveyance system; pipe, sanitary pipe fitting and valves. Performance characteristics and selection of centrifugal and positive displacement sanitary pumps. Design of CIP system.

Module IV: Design of heat exchange equipment-plate, scraped surface and extended surface for heating and cooling of gas and liquid.

Module V: Design of evaporator calandria, vapour separator and condenser, Design considerations for location of food plant. Equipment layout and ventilation in food process plants.

References:
1. D. Q. Kern, Process Heat Transfer,McgrawHill
2. J. H. Perry, Chemical Engineers Handbook, McgrawHill
3.. Howerd F. Rase Piping design for process plant, JohnWilley.
4. Stanley M. Walas Chemical Process Equipments , Butterworth, Heinemann.
5. Coulson and Richardson Chemical Engineering Design Vol-6, Butterworth, Heinemann

Gaps in the syllabus (to meet Industry/Profession requirements)

POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Quizzes (3)	3x10 = 30
Seminar	10

Teacher's Assessment	10
Semester End Examination	50

Indirect Assessment –

1.Student Feedback on Course Outcome

Mapping of Course Outcomes onto Program Outcomes

Course Outcome	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO 1	3	3	2	3	3	3	3	2	3	2	2	2	3	3	3
CO 2	3	2	2	2	3	3	3	2	3	2	2	2	3	3	3
CO 3	3	2	3	2	2	3	2	2	3	3	1	3	3	3	3
CO 4	2	2	3	3	3	3	2	3	3	3	2	2	3	3	3
CO 5	3	2	3	2	2	3	2	3	3	2	3	2	3	3	3

Correlation Levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

Mapping Between COs and Course Delivery (CD) methods

CD Code	Course Delivery methods	Course Outcome	Course Delivery Method Used
CD 1	Lecture by use of boards/LCD projectors/OHP projectors	CO1	CD1, CD2, CD8
CD 2	Tutorials/Assignments	CO2	CD1, CD2, CD8
CD 3	Seminars	CO3	CD1, CD2, CD4, CD8
CD 4	Mini projects/Projects	CO4	CD1, CD2, CD4, CD8
CD 5	Laboratory experiments/teaching aids	CO5	CD1, CD2, CD4, CD8
CD 6	Industrial/guest lectures		
CD 7	Industrial visits/in-plant training		
CD 8	Self- learning such as use of NPTEL materials and internets		
CD 9	Simulation		

COURSE INFORMATION SHEET

Course code: **FT 516**
Course title: **Agriculture and Rural Economics**
Pre-requisite(s):
Co- requisite(s):
Credits: **L:03 T:00 P:00**
Class schedule per week: **03**
Class: **IMSc**
Semester / Level: **IX/5**
Branch: **Food Technology**
Name of Teacher:

Course Objectives

This course enables the students:

1.	To understand nature and structure of rural economy, rural development and status of farmers in India
2.	To rural poverty and unemployment, role of SHGS and Micro Finance, programmes for rural development.
3.	To familiar with the problems associated with agricultural and Agricultural labour in India. Role of KVK, NGO and SHGS approach for development of Agricultural labour
4.	To understand Agricultural policies and their impact on Indian Agricultural
5.	To impart knowledge on issues related to lending to agricultural policies

Course Outcomes

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

CO1	To identify the causes of rural poverty and unemployment
CO2	To identify the methods of Agricultural extension and effective programmes for the removal of rural poverty and unemployment
CO3	To describe role of KVK, NGO and SHGS for rural development
CO4	To explain the mechanisms of KVK, NGO and SHGS
CO5	To infer Indian Agricultural Policy and Agricultural Labour Policy

Syllabus
FT 516 Agriculture and Rural Economics

Module: I (9)

Rural Economy- Introduction, nature and structure. Rural Development- Concept, Scope and Importance of Rural Development. V.M. Dandekar's approach to rural development. Agricultural extension, its importance and role, methods of evaluation of extension programmes. Socio-economic survey and status of big, small and marginal farmers and landless agricultural labourers.

Module:II (9)

Dimensions of Rural Development. Programmes of Rural Development. Agricultural Growth in India, Irrigation, Green Revolution, Agrarian Reforms, Rural Electrification, Rural Transport. Poverty and Unemployment-Nature, Causes and Remedies. Rural Indebtedness – Magnitude, Causes, Relief measures. Role of SHGs and Micro Finance in Rural Indebtedness. Rural Industrialization. Employment in unorganized sector.

Module:III (9)

Recent agricultural problems in India. Agricultural labour: Problems and Efficiency. Impacts of mechanization on Agricultural labour. Unemployment Problems and Employment Guarantee Schemes. Role of Krishi Vigyan Kendra (KVK), Non Government Organization (NGO) and self-help group approach for rural development

Module:IV (9)

Agricultural policy and impact : State Policies & Central Policies. Central policies comparison with world. Recent Indian Agricultural Labour Policy & its comparison with World. Ceiling on land holding policy. Past and Present SEZ policy.

Module:V (9)

Agricultural Export- Import Polices – history, recent changes & problems: Vegetables, Fruits, Spices, Flowers, Medicine, ornamental plants, Grain crops, Milk, Silk, Meat., EXIM Policy.

Books:

1. Government of India – Evolution of Community Development Programme in India
2. Desai, Vasant - Study of Rural Economics, Himalaya Publishing Company, New Delhi.
3. Jain P.C. – Agricultural Reforms in India
4. Shakuntala Devi – Rural Credit and Agricultural Development, Scrap & Sons,New Delhi 1996.
5. Patodiya Mohan S. - Rural Economics for C.A.I.I.BPart – I

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POs met through Gaps in the Syllabus

Topics beyond syllabus/Advanced topics/Design

POs met through Topics beyond syllabus/Advanced topics/Design

Course Outcome (CO) Attainment Assessment tools & Evaluation procedure

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Indirect Assessment –

1.Student Feedback on Course Outcome

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

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