VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M.Tech., FOOD BIOTECHNOLOGY (FDB)

(Effective from the Academic year 2022-23)

@# 03112023

Registrar,
Visvesvaraya Technological University
JnanaSangam, Machhe, Belagavi-590018
E Mail: registrar@vtu.ac.in
contact: 0831-2498112

Semester- I

Numerical Methods & Biostatistics (BSC)			
Course Code	22FDB11	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

To have insight into basics in statistics and numerical analysis.

To enable the students to tackle live problems in various spheres of bioscience and bioengineering

To learn and design various statistical problems

Module-1

INTRODUCTION TO STATISTICS AND STUDY DESIGN:

Introduction to statistics, data, variables, types of data, tabular, graphical and pictorial representation of data. Significance of statistics to biological problems, experimental studies; Randomized controlled studies, historically controlled studies, cross over, factorial design, cluster design, randomized; complete, block, stratified design, biases, analysis and interpretation

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

	Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-2

DESIGN:

Types of variables, measure of spread, logarithmic transformations, multivariate data. Basics of study design, cohort studies, case-control studies, outcomes, odd ratio and relative risks. Principles of statistical inference: Parameter estimation, hypothesis testing. Statistical inference on categorical variables; categorical data, binomial distribution, normal distribution, sample size estimation.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

COMPARISON OF MEANS:

Test statistics; t-test, F distribution, independent and dependent sample comparison, Wilcoxon Signed Rank Test, Wilcoxon-Mann-Whitney Test, ANOVA. Correlation and simple linear regression: Introduction, Karl Pearson correlation coefficient, Spearman Rank correlation Co- efficient, simple linear regression, regression model fit, inferences from the regression model, ANOVA tables for regression. Multiple linear regression and linear models: Introduction, Multiple linear regression model, ANOVA table for multiple

linear regression model, assessing model fit, polynomials and interactions. One-way and Two way ANOVA tables, T-tests; F-tests. Algorithm and Implementation using numerical methods with case studies	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
DESIGN AND ANALYSIS OF EXPERIMENTS: Random block design, multiple sources of variation, correlated data and random effects regression, model fitting. Completely randomized design, stratified design. Biological study designs. Optimization strategies with case studies.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5	
STATISTICS IN MICROARRAY, GENOME MAPPING AND BIOINFORMATICS: Types of microarrays, objectives of the study, experimental designs for micro array studies, microarray analysis, interpretation, validation and microarray informatics. Genome mapping, discrete sequence matching	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Biostatistics, Alvin E. Lewis, McGraw-Hill Professional Publishing, 2013
2. Statistics and Numerical Methods in BASIC for Biologists, D. Lee and T.D. Lee, Van Nostrand Reinhold Company, 1982
3. Numerical Methods, Wolfgang Boehm and Hartmut Prautzsch, CRC Press, 1993
4. Numerical Methods of Statistics, John F. Monahan, Cambridge University Press, 2011
5. Numerical Methods for Engineers and Joe D. Hoffman CRC Press 2001
6. Statistical Methods in Bioinformatics: An Introduction Warren, J. Ewensregory Grant, Springer Science & Business Media, 2005.
7.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/102/106/102106051/
2. https://archive.nptel.ac.in/courses/111/102/111102112/ https://archive.nptel.ac.in/courses/103/106/103106120/
3. https://www.youtube.com/watch?v=KhjM8YI3agk
4. https://nptel.ac.in/courses/102106065

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand principles of bioengineering.	L3, L4
CO2	Apply the principles of Chemical Engineering in Bioprocess.	L3, L4
CO3	Use relevant data from hand books to design bioreactors / fermenters	L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2								
CO2	3	3	3	2								
CO3	3	3	1	2	2							

Semester - I

Food Biochemistry and Microbiology + lab (IPCC)			
Course Code	**22FDB12**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- To understand and proteins, carbohydrates and lipids for utilization in food processing
- To understand different kinds of nutrient supplements and their chemistry
- To understand different factors affecting microbial growth and survival in foods
- To understand different microbial fermentations and analyze problems during the processing of fermented food products
- To analyze causes for food borne diseases and evaluate food samples by different methods for microbial contamination
- To create appropriate strategies for food preservation and controlling microbial quality of foods

MODULE-1

PROPERTIES OF FOODS

Nomenclature, classification, structure, chemistry, properties, analysis of proteins, carbohydrates and lipids. Factors affecting their properties and changes during food processing. Classification and functions, need for food ingredients and additives.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

MODULE-2

HUMAN NUTRITION AND DIETARY REQUIREMENTS

Introduction to human nutrition, energy value of foods and its determination by calorimetry and from proximate principles, daily caloric needs for basal metabolism, physical activity and diet induced thermogenesis. Requirements and role of carbohydrates, lipids, water, vitamins and minerals in human health, recommended dietary allowance (RDA), dietary sources.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

MODULE-3

MICROBIAL GROWTH:

Types of microorganisms, their importance in foods, classification of food borne bacteria, fungi & yeast, their morphology and distinguishing features with examples; Growth of microorganisms in foods; Intrinsic (pH, moisture content, redox potential,

nutrient content, antimicrobial constituents and biological structures) and extrinsic factors (temp, +RH, presence and concentration of gases) governing growth of microorganisms in food.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
MODULE-4	
FOOD SPOILAGE: Chemical changes caused by microorganisms in foods (breakdown of proteins, carbohydrates, fats and other constituents during spoilage), specific microorganisms causing spoilage of milk and milk products, meat, fish, egg, cereals, fruits, vegetables and their processed products, quality defects in canned foods, sugar and confectionary products. Different types of fermentations. Startercultures, Probiotic cultures, Fermented foods.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

	Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
MODULE 5	
Microbial food borne diseases and detection of microbes Types of microbial food borne diseases, symptoms and prevention of some commonly occurring food borne diseases, detecting food borne pathogens and their toxins- conventional versus rapid and automated methods; genetic and immunologic techniques for detecting food borne pathogens and toxins. Food preservation by controlling microbes. Principles of preservation, methods of food preservation ,antimicrobial agents, hurdle technology, active packaging, novel processing technologies.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Experiment to study the properties of carbohydrates- caramelization, Mailard reaction.
2	Determination of Foaming properties of proteins

3	Estimation of free fatty acid content of oil
4	Microbiological quality of water (MPN)
5	Enumeration of Lactic acid bacteria from fermented foods
6	Yeast and Mould count from fruits
7	Enumeration of spores from pepper
8	Inhibitory effect of spices on microbial load in fish and flesh foods
9	Enumeration and Isolation of E. coli from processed meat/chicken
10	Thermal destruction of microbes TDT and TDP
11	Enumeration and Isolation of Staphylococci from ready to eat street foods
12	Effect of cleaning and disinfection on microbial load

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks**

Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**

Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be

proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10

(50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Lehninger Principles of Biochemistry, David L. Nelson, WH Freeman, 2017
2. Textbook of biochemistry (4th edition). E. S. West, W. R. Todd, H. S. Mason, and J. T. Van Bruggen. MacMillan, New York,
3. 1966
4. Nutrition and Dietetics Paperback , Shubhangini A. Joshi, McGraw Hill Education, 2017
5. General Biochemistry. J.H. Weil, New Age International, 2005
6. Biochemistry of Foods. N.A.M Eskin, Elsevier, 1971
7. Food Chemistry. O.R. Fennema, CRC Press, 2008
8. Food Microbiology. Adams MR and Moss MO, RSC Publishing, 3rd Edition, 2008
9. Fundamentals of Food Microbiology. Bibek Ray, CRC press, 3rd Edition, 2005
10. Modern Food Microbiology, James M. Jay, Martin J. Loessner, David A. Golden, 2005
11. Essentials of Food Microbiology. John Garbutt, Arnold, 1997

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/104/126104004/

2. https://archive.nptel.ac.in/courses/126/104/126104004/
3. https://www.youtube.com/watch?v=AMJYn3hgv3o
4. https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-bt21/
5. https://dth.ac.in/medical/courses/Microbiology/block-1/2/index.php

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand and Analyse biopolymers for utilization in food processing	L1, L2, L3
CO2	Analyse and evaluate levels of food ingredients and addition for the acceptability of food products	L1, L2, L3,L4
CO3	Understand different factors affecting microbial growth and cause of spoilage	L1, L2, L3, L4
CO4	Analyze causes for food borne diseases and evaluate food samples by different methods for	L1, L2, L3,L4,L5
CO5	Create appropriate strategies for food preservation and controlling microbial quality of foods	L1, L2, L3,L4,L5,L6

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	PO1
2	Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	PO2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	PO5
6	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
7	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and	PO7

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3		3	3	3				
CO2			2	3	3							
CO3			2	3								
CO4				3								
CO5	2		3	3	3							

@# 03112023

Semester I

Functional Foods and Nutraceuticals (PEC-2)			
Course Code	22FDB13	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	4	Exam Hours	3

Course Learning objectives:

- To understand various food ingredients and their functional properties.
- To apply his understanding to select appropriate food for particular disease control.
- To understand and evaluate functional foods with respect to different regulations.
- To analyze the functional claims with respect to packaging and labelling.
- To apply various regulations and laws imposed for functional food.

Module-1

INTRODUCTION

Functional foods- concept and definition; nutraceutical-concept and definition. Probiotics, prebiotics and dietary fibres – their functional properties Functional foods-the link between nutrition and medicine, sources and bioavailability of nutraceuticals, chemistry and structure of nutraceuticals

Teaching-Learning	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint

Process	presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
FUNCTIONAL FOOD COMPONENTS AND THEIR ROLES IN DISEASE PREVENTION Micronutrients, Vitamins, Isoflavones; Flavanoids, Carotenoids and Lycopene; Nutraceuticals – Garlic, Grape, Wine, Tea; Omega 3 Fatty Acids, Antioxidant, Chemoprevention & Functional Food; Single Cell Proteins. Functional foods for treatment of gastrointestinal disorders, Functional Food and Nutraceuticals for the treatment of Coronary Heart Disease, Role of Functional Food and Nutraceuticals in Tumor. Nutraceuticals and Functional Foods from Marine: Marine Macroalgae, Microalgae, Bacteria, Fungi, Cyanobacteria and their Therapeutic Applications. Marine-Derived Nutraceuticals for Prevention and Development of Atherosclerosis	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	

NUTRACEUTICALS OF PLANT AND ANIMAL ORIGIN Plant secondary metabolites: Role of Plant Sterols and Phytoestrogens in Functional Foods, Phenolics in Herbal and Nutraceutical Products. Animal metabolites: Fat rich functional food and their applications - Functional Fats and Spreads, modified fats and oils. Functional Meat as Functional Foods, Functional Confectionery and other functional Products	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
FUNCTIONAL FOOD HEALTH CLAIMS Functional claims; packaging and labeling; nutrient modification and specific nutrient claims; disease-specific claims; Dietary Supplement Health and Education Act (DSHEA).	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

	Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
MARKETING AND REGULATION OF FUNCTIONAL FOODS Market for Functional Food Products: Functional foods and consumers; the role of health in food choice; functional foods market; Regulations and laws for functional food. Regulations in USA, EU and India.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Functional Foods: Principles and Technology. M. Guo, Woodhead Publishing, 1st Edition
2. Functional foods-Concept to product. Gibson G.R., Williams G.M. Woodhead Publishing Ltd, 2000
3. Handbook of Nutraceuticals and Functional Foods. Wildman R.E.C., Second Edition, CRC Press, 2007
4. Handbook of fermented functional foods. Farnworth E.R., CRC Press, 2003
5. Phytochemical functional foods. Johnson I., Williamson G. Woodhead Publishing Ltd, 2000
6. Phytosterol as functional food components and nutraceuticals. Dutta P.C., Marcel Dekker, 2004
7. Functional food ingredients and nutraceuticals. Shi J., Taylor and Francis, 2007
8. Biotechnology in functional foods and nutraceuticals. Bagchi D., Lau F.C., Ghsh, D.K., Taylor and Francis, 2010
9. Dietary supplements and functional foods. Webb, G.P., Blackwell Publishing, 2006

Web links and Video Lectures (e-Resources):

1. https://www.classcentral.com/course/swayam
2. https://www.functionalfoodscenter.net/OnlineCourses.html
3. https://academy.nutrifytoday.com/
4. https://www.youtube.com/watch?v=gCeSLR5PFIc

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand various food ingredients and their functional properties	L1, L2,
CO2	Apply his understanding to select appropriate food for particular disease control.	L3, L4, L5
CO3	Understand and evaluate functional foods with respect to different regulations.	L3, L4, L5
CO4	Analyze the functional claims with respect to packaging and labelling	L3, L4, L5
CO5	Apply various regulations and laws imposed for functional food.	L3, L4,

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	PO8

Mapping of COS and POs

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

Semester- I

Food Engineering -I (PCC)			
Course Code	**22FDB14**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course objectives:

- To understand food properties and food processing at ambient temperature
- To apply food processing methods at ambient temperature
- To apply and evaluate heat application methods for food processing

Module-1

Properties of Foods & Food Processing at ambient temperature I

Properties of Foods: Composition, Physical, Rheological and biochemical properties, Sensory characteristics, Nutritional quality Food Processing at ambient-temperature: Raw Food Processing- Cooling crops and carcasses; Cleaning- wet and dry cleaning; Sorting and grading- shape and size sorting, weight sorting, colour and machine vision sorting and grading; Peeling Reduction of Size- Solid foods- Theory, equipment, developments in size reduction technology, effects on foods and microbes; Liquid foods- Theory, emulsifying agents and stabilizers, equipment, effect on foods and microbes

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-2	
Food Processing at ambient temperature II Mixing and Forming- Mixing-Theories of solids and liquids mixing, equipment, effect on foods and microorganisms; Forming- Bread moulders, pie, tart and biscuit formers, confectionery moulders and depositors. Separation and Concentration of components of Food: Theory and equipment for Centrifugation, Filtration and Expression; Solvent Extraction- Theory, solvents, supercritical CO2, Equipment; Membrane concentration- theory, equipment and applications, types of membrane system, effect on foods and microorganisms.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-3	

Food processing by heat removal

Chilling and modified atmospheres- theory-refrigeration, modified atmospheres; equipment- mechanical refrigerators, cryogenic chilling, cold storage, temperature monitoring, modified and controlled atmospheric storage; applications- fresh and processed foods; effects on sensory and nutritional qualities of foods & microbes. Freezing- theory- ice crystal formation, solute concentration, freezing time calculation, thawing; equipment- mechanical freezers, cryogenic freezers, new developments in freezing, frozen storage, thawing; effect on foods- freezing, frozen storage and thawing; effect on microbes. Freeze drying- Theory, equipment and effect on foods and microbes; Freeze concentration- Theory, equipment and effect on foods and microbes.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-4

Food Processing by heat application

Heat Processing – Theory- Thermal properties of foods, heat transfer; Heat sources and application methods- direct and indirect heating methods, energy use and methods to reduce energy consumption, types of heat exchangers; Effect of heat on microbes, enzymes, nutritional and sensory characteristics of food.

Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

Food Processing by heat application

Processing by heat using steam or water: Blanching- Theory, Equipment- steam blanchers, hot water blanchers, new blanching methods, effect on food and microbes;Pasteurisation- Theory, Equipment- pasteurization of packaged and unpackaged foods, effect on foods; Sterilization by heat- In container sterilization- theory, retorting, equipment, Ultra high temperature (UHT)/aseptic processes- theory, processing, equipment, effect on food canning, UHT processing; Evaporation- theory, improvement of evaporation economics, equipment, effect on foods and microbes; Distillation- theory, equipment, effect on foods and microbes; Extrusion- theory of extrusion cooking- ingredient properties, operating characteristics of extruder; equipment- single and twin screw extruders, control of extruders; food applications- confectionery, cereal and protein based products; effects on sensory characteristics and nutritional value of foods & microorganisms

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Food processing technology - principles and practice. P.J. Fellows, CRC press, 3rd edition, 2009
2. Introduction to Food Engineering. R Paul Singh & Dennis R Heldman, Amsterdam Elsevier/Academic Press, 4th Edition, 2009
3. Fundamentals of food engineering. D.G. Rao, PHI Learning Private Limited, New Delhi, 2010
4. Food process engineering and technology. Zeki Berk, 1st edition, 2009, CRC Press, New York
5. Trends in Food Engineering. Jorge E. Lozano, Cristina Anon, Gustavo V. Barbosa-Canovas, Efren Parada-Arias, CRC Press; 1st Edition, 2000
6. Novel Food Processing Technologies (Food Science and Technology Series). Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Publisher: CRC Press, 1st Edition, 2004
7. Minimal Processing Technologies in the Food Industry. Thomas Ohlsson and Nils Woodhead Publishing Limited, 1st Edition, 2002

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105011/
2. https://archive.nptel.ac.in/courses/126/105/126105015/
3. https://onlinecourses.nptel.ac.in/noc22_ag03/preview
4. https://onlinecourses.nptel.ac.in/noc19_ag02/preview
5. https://onlinecourses.nptel.ac.in/noc22_ch53/preview

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand food properties and food processing at ambient temperature	L1, L2, L3
CO2	Apply food processing methods at ambient temperature	L1, L2, L3
CO3	Apply and analyze heat removal methods for food processing	L1, L2, L3,L4
CO4	Understand heat processing for food applications	L1, L2, L3
CO5	Apply and evaluate heat application methods for food processing	L1, L2, L3,L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex	2

	engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	
3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
5	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**								
CO2				**3**								
CO3	**2**		**2**	**3**								
CO4				**3**								
CO5	**2**		**2**	**3**	**2**							

Principles of Food Analysis and Food law (PCC)			
Course Code	22FDB15	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn errors and uncertainty of analytical results;
- To learn measures taken to control quality and ensure reliability of analytical results.
- To learn the application fermentation technology to produce commercially important food products
- To learn the evaluation of food analysis by different analytical methods.
- To learn the International Food Policies in Food sector development

Module-1

INTRODUCTION TO FOOD ANALYSIS:

Types of food samples analysed, steps in food analysis, choice of methods; sampling procedures, considerations and sample preparation; Evaluation of analytical data – accuracy and precision, sources of errors, specificity, sensitivity and detection limits, regression analysis, reporting results.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-2	
CHARACTERISTICS OF FOOD ANALYSIS: Analysis of chemical constituents, their characterization and significance – moisture, ash, minerals, lipids, fat, proteins, fibre, titratable acidity, starch, reducing sugars. Methods in food analysis: Spectroscopic analysis of foods – basic principles, UV, visible, fluorescence, IR, AAS, MS, NMR; Chromatographic analysis of foods – basic principles, HPLC, GC, GLC, principles and applications.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-3	
REGULATIONS AND CERTIFICATIONS: Various laws, regulations and Certifications for food processing, Essential Commodity Act, Prevention of Food Adulteration Act (PFA), Fruit Products Order (FPO).	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-4	
FOOD SAFETY AND STANDARDS: Meat Food Products Order (MFPO), Vegetable Oil Control Order, Agricultural Marketing and Grading Standards (AGMARK).Bureau of Indian Standards (BIS) and their certifications, Food Safety and Standards Authority of India (FSSAI), Food Safety and Standards Act and Regulations of India.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	

FOOD LAWS: Food Codex laws, Food and Drug Administration (FDA), International Organization for Standardization (ISO), Good Manufacturing Practices (GMP), Good Agricultural Practices (GAP), Hazard Analysis and Critical Control Point (HACCP).	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. Three Unit Tests each of **20 Marks**
2. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Encyclopedia of Food Safety by Yasmine Motarjemi, 2013
2. Encyclopedia of Food Microbiology by Carl A. Batt; Pradip Patel; Richard K. Robinson, 2014
3. Understanding Codex by Food and Agriculture Organization (FAO) Staff, 2018

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. https://archive.nptel.ac.in/courses/126/105/126105013/
3. https://onlinecourses.swayam2.ac.in/cec20_ag06/preview
4. https://onlinecourses.swayam2.ac.in/nou21_ag02/preview

Skill Development Activities Suggested

1. Organoleptic analysis of given food sample.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Identify and determine error sandun certainty of analytical results	L1, L2, L3
CO2	Apply measures taken to control quality and ensure reliability of analytical results.	L1, L2, L3
CO3	Apply the knowledge for production of fermented foods	L1, L2, L3
CO4	Learn evaluation of food analysis by different analytical methods.	L1, L2, L3
CO5	Analyse and implement food lays to every aspects of food processing	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	**Apply the knowledge of International Food Policies in Food sector development** **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3
2	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	4
3	**The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	5
4	**Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	6
5	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	7

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1			3	3	3	3	3			
CO2			3	3	3	3	3			
CO3			3	3	3	3	3			
CO4			3	3	3	3	3			
CO5			3	3	3	3	3			

Semester- I

Research Methodology and IPR (PCC)			
Course Code	**22RMI16**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn research methodology and the technique of defining a research problem
- To learn significance of literature review in research, and to carry out a literature search, develop theoretical and conceptual frameworks and writ a review.
- To learn various research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.
- To learn several parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports
- To learn various forms of the intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR

Module-1

RESEARCH METHODOLOGY:

Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-2	
REVIEWING THE LITERATURE: Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-3	

DESIGN OF SAMPLING: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-4	
TESTING OF HYPOTHESES: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi- square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports.

Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial

Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated Circuits, Protection of Undisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

3. Three Unit Tests each of **20 Marks**
4. Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

1. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.
2. The question paper will have ten full questions carrying equal marks.
3. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.
4. Each full question will have a sub-question covering all the topics under a module.
5. The students will have to answer five full questions, selecting one full question from each module

Suggested Learning Resources:

Books

1. Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg, New Age International, 2018
2. Research Methodology a step- by-step guide for beginners(For the topic Reviewing the literature under module 2), Ranjit Kumar, SAGE, Publications, 2011.
3. Study Material (For the topic Intellectual Property under module 5), Professional Programme Intellectual Property Rights, Law and Practice, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, The Institute of Company Secretaries of India, Statutory Body Under an Act of Parliament, 2013
4. Conducting Research Literature Reviews: From the Internet to Paper Fink A Sage Publications, 2009

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/121/106/121106007/
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. https://archive.nptel.ac.in/courses/110/105/110105091/
4. https://archive.nptel.ac.in/courses/102/106/102106051/
5. https://www.youtube.com/watch?v=aKohB8lPueg
6. https://archive.nptel.ac.in/courses/110/105/110105091/

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Apply basics of research methodology to defining a research problem	L3, L4
CO2	Perform literature search, developing theoretical and conceptual frameworks and write a review.	L3, L4
CO3	Analyze and evaluate research designs, sampling designs, measurement and scaling techniques and also different methods of data collections.	L4,L5
CO4	Apply parametric tests of hypotheses, Chi-square test, art of interpretation and writing research reports.	L4,L5
CO5	Evaluate different types of intellectual property, its relevance and business impact in the changing global business environment and leading International Instruments concerning IPR	L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3	**Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
4	**Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5

Mapping of COS and POs

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

Semester I

Food Biotechnology Lab I (PCCL)			
Course Code	22FDBL17	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	2	Exam Hours	3

Course objectives:

- To learn different methods of food preservation methods.
- To learn the performance of different food processing equipment.
- To learn the physical properties of different food grains.
- To learn the analysis of energy and material balances of food processes

Sl.NO	Experiments
1	Preservation of fruits and vegetables by osmotic dehydration, salting and canning
2	Yield and performance evaluation of juice extraction and processing
3	Studying the effect of chemical preservatives on the shelf life of juices and pastes
4	Determination of physical properties of grains, cereal and spice seeds
5	Determination of coefficient of static friction for grain against different surfaces and angle of repose
6	Energy consumption, yield and performance during size reduction of cereals.
7	Estimation of drying curve of vegetables in an plate dryer
8	Estimation of freezing time in a blast freezer.
	Demonstration Experiments For CIE
9	Determination of drying and rehydrating of vegetables in freeze dryer.
10	Determination of drying of vegetables in a microwave dryer and hot air dryer.
11	Determination of dehydration of vegetables in salt and brine
12	Determination of thermal process time for sterilization

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Learn different food preservation methods.
- Evaluate the performance of different food processing equipment.
- Determine physical properties of different food grains.
- Analyse the energy and material balances of food processes

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

1. Unit Operations of Agricultural Processing. K.M. Sahay and K.K. Singh, Vikas Publishing House Pvt. Ltd., 2nd Edition, 2004.
2. Experimental Methods in Food Engineering, Rizvi, S.S.H. and Mittal, G.S., Springer US, 1st Edition, 1992
3. Introduction to Food Engineering. R Paul Singh & Dennis R Heldman, Amsterdam Elsevier/Academic Press, 4th Edition, 2009

Semester- I

BOS recommended ONLINE courses (AUD/AEC)			
Course Code	**22AUD18/22AEC18**	CIE Marks	Evaluation procedures are as per the policy of the online course providers.
Teaching Hours/Week (L:P:SDA)	Classes are as per the policy of the online course providers.	SEE Marks	
Total Hours of Pedagogy		Total Marks	
Credits	pp	Exam Hours	

BOS RECOMMENDED ONLINE COURCES

1. Advanced Aquaculture Technology
2. Advanced Chemical Theory
3. Advanced Protein chemistry
4. Advanced Thermodynamics
5. An Introduction to Cardiovascular Fluid Mechanics
6. Animal Physiology
7. Applied Environmental Microbiology
8. Basic Principles and Calculations in Chemical Engineering
9. Bioenergetics of Life Processes
10. Bioenergy
11. Bioengineering : An Interface with Biology and Medicine
12. Biomedical nanotechnology

13.	Biomicrofluidics
14.	Bioreactors
15.	Cell Culture Technologies
16.	Cellular biophysics: a framework for quantitative biology
17.	Computational Fluid Dynamics
18.	Computational Systems Biology
19.	Computer Aided Applied Single Objective Optimization
20.	Computer Aided Drug Design
21.	Conservation Geography
22.	Current regulatory requirements for conducting clinical trials in India for investigational new
23.	Dairy And Food Process And Products Technology
24.	Data Science for Engineers
25.	Descriptive Statistics with R Software
26.	Design Thinking - A Primer
27.	Design, Technology and Innovation
28.	Diary and food process and products technology
29.	Drug Delivery: Principles and Engineering
30.	drug/new drug (Version 2.0)
31.	Effective Engineering Teaching In Practice
32.	Electrochemical Technology in Pollution Control

@# 03112023

33.	Electronic Waste Management - Issues And Challenges
34.	Employment Communication A Lab based course
35.	Energy Resources, Economics and Environment
36.	Entrepreneurship Essentials
37.	Environmental Biotechnology
38.	Environmental Quality Monitoring & Analysis
39.	Environmental Remediation of Contaminated Sites
40.	Equipment Design : Mechanical Aspects
41.	Essentials of Biomolecules : Nucleic Acids and Peptides
42.	Ethics in Engineering Practice
43.	Experimental Biotechnology
44.	Forest Biometry
45.	Forests and their management
46.	Functional Genomics
47.	Fundamentals Of Food Process Engineering
48.	Fundamentals Of Micro And Nanofabrication
49.	Fundamentals of Protein Chemistry
50.	Fundamentals of Spectroscopy
51.	Fuzzy Logic and Neural Networks
52.	General Microbiology

53.	Genetic Engineering: Theory and Application
54.	Genome Editing and Engineering
55.	Geographic Information System
56.	Health Research Fundamentals
57.	Human Behaviour
58.	Human Molecular Genetics
59.	Immunology
60.	Industrial Biotechnology
61.	Innovation by Design
62.	Instrumentation
63.	Intellectual Property
64.	Interactomics : Basics & Applications
65.	Introduction to Biomedical Imaging Systems
66.	Introduction to Biostatistics
67.	Introduction to Brain & Behaviour
68.	Introduction to Cell Biology
69.	Introduction to Cognitive Psychology
70.	Introduction to Developmental Biology
71.	Introduction to Dynamical Models in Biology
72.	Introduction to Environmental Economics

73.	Introduction to mechanobiology
74.	Introduction To Process Modelling In The Membrane Separation Process
75.	Introduction to Professional Scientific Communication
76.	Introduction to Proteogenomic
77.	Introduction To Proteomics
78.	Introductory Mathematical Methods for Biologists
79.	Manage TB
80.	Material and Energy Balances
81.	Matlab Programming for Numerical Computation
82.	Medical Biomaterials
83.	Medicinal Chemistry
84.	Membrane Technology
85.	Multiphase Flows
86.	Non-Conventional Energy Resources
87.	Offshore Structures Under Special Environmental Loads Including Fire Resistance
88.	Optical Spectroscopy and Microscopy : Fundamentals of optical measurements and
89.	Optimization in Chemical Engineering
90.	Organic farming for sustainable Agricultural production
91.	Patent Drafting for Beginners
92.	Patent Law for Engineers and Scientists

93.	Physics of Biological Systems
94.	Physics through Computational Thinking
95.	Plant Cell Bioprocessing
96.	Plastic Waste Management
97.	Post-Harvest Operations and Processing of Fruits, Vegetables, Spices and Plantation Crop Products
98.	Principles and Applications of NMR Spectroscopy
99.	Principles Of Downstream Techniques In Bioprocess
100.	Process Control - Design, Analysis and Assessment
101.	Product Design and Innovation
102.	Programming, Data Structures And Algorithms Using Python
103.	Protein folding
104.	Qualitative Research Methods and Research Writing
105.	Quantitative Methods in Chemistry
106.	Regulatory requirements for medical devices including in vitro diagnostics in India (Version
107.	Roadmap for patent creation
108.	Soft Nano Technology
109.	Strategic Performance Management
110.	The Joy of Computing using Python
111.	Thermal Processing of Foods
112.	Thermodynamics for Biological Systems : Classical and Statistical Aspect

113.	Tissue Engineering	**Semester**
114.	Transport Phenomena in Biological Systems	**II**
115.	Advanced Chemical Thermodynamics and Kinetics	
116.	Ultrafast laser spectroscopy	
117.	Understanding Design	
118.	Waste to Energy Conversion	

Classes and evaluation procedures are as per the policy of the online course providers.

Food Biotechnology (PCC)			
Course Code	22FDB21	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn how biotechnology can be utilized for improving the nutritional content of foods stuff.
- To learn how biotechnology can be utilized for minimize the unwanted content of foods stuff.
- To learn how biotechnology can be utilized for improving the shelf life of foods stuff.

Module-1

INTRODUCTION

Principles and methods of plant tissue culture, development of transgenic plants.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
ENHANCING THE NUTRITIONAL QUALITY Enhancing the nutritional quality of foods- manipulation of sucrose and starch content: manipulation of fatty acid composition of oils, enriching with protein content, increasing the content of methionine and lysine in feed storage proteins increasing the levels of	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	

MINIMISING LOSS: Removal or minimizing theantinutritional factors and toxic molecules from foodphytate, oxalic acids, neurotoxins etc., decreasing the contents of pesticides, herbicidesand heavy metals-use of bioinsecticides, development of herbicide resistant plant etc	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
INCREASING THE SHELF LIFE OF THE FRUITS Increasing the shelf life of the fruits- Development of food value metabolites sweeteners etc	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data.

	Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
PLANT BIOTECHNOLOGY Animal biotechnology for increasing meat quality and meet production	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Rutledge, Food and Nutritional Biotechnology, Navyug Publishers &distributors, 2009
2. Ravishankar Rai V, Advances in Food Biotechnology, WilesBlackwell, 2018

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. https://archive.nptel.ac.in/courses/126/105/126105011/
3. https://onlinecourses.nptel.ac.in/noc22_ag03/preview

Skill Development Activities Suggested

1. AV presentation by students (on topics as per choice of the teacher)
2. Online tools for surprise quizzes
3. Collection of case studies based on research findings
4. Model making and Poster presentations on specific case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Leve
CO1	To learn how biotechnology can be utilized for improving the nutritional content of foods stuff.	L1, L2, L3
CO2	To learn how biotechnology can be utilized for minimize the unwanted content of foods stuff	L1, L2, L3
CO3	To learn how biotechnology can be utilized for improving the shelf life of foods stuff.	L1, L2, L3

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
4	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
5	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1	3	2	2		3	3						
CO2	2	2	2		3	3						
CO3	2	2	2		3	3						

Semester - II

Food Process Engineering +Lab (IPCC)			
Course Code	**22FDB22**	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:2:0	SEE Marks	50
Total Hours of Pedagogy	40 hours Theory + 10-12 Lab slots	Total Marks	100
Credits	4	Exam Hours	3

Course objectives:

- To apply and evaluate irradiation and high pressure for food processing
- To apply and evaluate minimal methods for food processing
- To apply and evaluate heat for food processing applications
- To apply and evaluate ohmic and infrared heating for food processing
- To apply and evaluate extraction and hurdle technology for food processing

MODULE-1

FOOD PROCESSING AT AMBIENT-TEMPERATURE

Irradiation- theory-dose distribution; equipment-radiation dose measurement; applications- radappertisation, radicidation, radurisation, ripening control, disinfection, sprouting inhibition; effect on foods- induced radioactivity, radiolytic products, nutritional and sensory qualities; effect on microbes; effect on packaging; detection of irradiated foods- physical, chemical and biological methods. High pressure processing of Foods- theory- effect on food components, mechanism of microbial cell inactivation; equipment- batch operation, semi continuous operation, process developments; effect on parasites and microbes- yeasts, moulds, bacteria, viruses; effect on enzymes; effect on foods; combinations of high pressure and other

minimal processing techniques	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
MODULE-2	
FOOD PROCESSING AT AMBIENT-TEMPERATURE Minimal Food processing methods- Processing by Pulsed electric field (PEF)- theory, equipment, effects on microbes, enzymes and food components, combinations of PEF and other treatments; Processing by electric arc discharges and oscillating magnetic fields; Processing with pulsed light, UV light and pulsed X-rays- theory, equipment, effects on microbes, enzymes and food components; Processing by ultrasound- theory, processing, effects on microorganisms and foods; Microwave processing.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
MODULE-3	
Food Processing by heat application Processing by heat using hot air: Dehydration (Drying)- theory- drying with heated air and heated surfaces, intermediate moisture foods; equipment- hot air driers, heated surface (contact) driers, control of dryers, rehydration; effect on sensory and nutritional properties of food and microbes. Smoking- theory- smoke constituents, liquid smoke; processing equipment; effect on foods and microorganisms. Baking and Roasting- theory; equipment- batch and semi continuous ovens, continuous ovens, control of ovens; effects on sensory and nutritional qualities of foods & microorganisms .Processing by heat using hot oils: Frying- theory-heat and mass transfer, frying time and temperature; equipment- atmospheric fryers, vacuum and pressure fryers, fryer operation control, oil filtration and heat recovery; oils used for frying and effect of frying on oils; effect of frying on foods- oil absorption, changes to texture, colour and flavour & nutritional changes; effect of frying on microbes.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

MODULE-4	
FOOD PROCESSING BY HEAT APPLICATION Heat processing by direct and radiated energy: Dielectric heating- theory, equipment, applications, effect on foods and microbes. Ohmic heating- theory, equipment, applications, effect on foods and microbes Infrared heating- theory, equipment, applications, effect on foods and microbes	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

MODULE 5
EXTRACTION & HURDLE TECHNOLOGY Extraction- Solid-liquid extraction (Leaching)- types of extraction processes; extraction principles- counter current extraction, McCabe-Thiele method, right angled triangle method; equipment- batch extractor, continuous counter current extractor, multi stage continuous counter current extractor; extraction applications in food processing- extraction of oils & fats, oleoresins, food colours, coffee, flavours and pigments. Hurdle technology- Basics of hurdle technology – Mechanism, Application to foods - Newer Chemical and Biochemical hurdles- organic acids – Plant derived, antimicrobials – Antimicrobial enzymes – bacteriocins – chitin /

chitosan (only one representative example for each group of chemical and biochemical hurdle)	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

PRACTICAL COMPONENT OF IPCC

Sl.NO	Experiments
1	Comparative study of the total bacterial count of food exposed to UV and food kept at ambient temperature
2	Comparative study of the organoleptic characteristics of food processed by high temperature and kept at ambient temperature
3	Comparative study of the total bacterial count of food processed in microwave and food kept at ambient temperature
4	Comparative study of the organoleptic characteristics of food processed in microwave oven and food kept at ambient temperature
5	Comparative study of the total bacterial count of food exposed to contact heater and hot air heater

6	Comparative study of the organoleptic characteristics of food processed by contact heater and hot air heater
7	Comparative study of the total bacterial count of smoke food and food kept at ambient temperature
8	Comparative study of the organoleptic characteristics of smoke food and food kept at ambient temperature
9	Comparative study of the organoleptic characteristics of salted food and food kept at ambient temperature
10	Comparative study of the total bacterial count of oil fried food and food kept at ambient temperature
11	Comparative study of the organoleptic characteristics of oil fried food and food kept at ambient temperature (Demonstration Experiments For CIE)
12	Comparative study of the organoleptic characteristics of baked food and roasted kept at ambient temperature (Demonstration Experiments For CIE)

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of IPCC

Two Tests each of **20 Marks**

Two assignments each of **10 Marks/One Skill Development Activity of 20 marks**

Total Marks of two tests and two assignments/one Skill Development Activity added will be CIE for 60 marks, marks scored will be proportionally scaled down to **30 marks**.

CIE for the practical component of IPCC

On completion of every experiment/program in the laboratory, the students shall be evaluated and marks shall be awarded on the same day. The**15 marks** are for conducting the experiment and preparation of the laboratory record, the other **05 marks shall be for the test** conducted at the end of the semester.

The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to 15 marks.

The laboratory test at the end /after completion of all the experiments shall be conducted for 50 marks and scaled down to 05 marks**.**

Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **20 marks**.

SEE for IPCC

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours)

The question paper will be set for 100 marks and marks scored will be scaled down proportionately to 50 marks.

The question paper will have ten questions. Each question is set for 20 marks.

There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module.

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper shall include questions from the practical component).

The minimum marks to be secured in CIE to appear for SEE shall be the 15 (50% of maximum marks-30) in the theory component and 10 (50% of maximum marks -20) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in

SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 questions to be set from the practical component of IPCC, the total marks of all questions should not be more than the 20 marks.

SEE will be conducted for 100 marks and students shall secure 40% of the maximum marks to qualify in the SEE. Marks secured will be scaled down to 50. (Student has to secure an aggregate of 50% of maximum marks of the course(CIE+SEE)

Suggested Learning Resources:

Books

1. Food processing technology - principles and practice. P.J. Fellows, CRC press, 3rd edition, 2009
2. Introduction to Food Engineering. R Paul Singh & Dennis R Heldman, Amsterdam Elsevier/Academic Press, 4th Edition, 2009
3. Fundamentals of food engineering. D.G. Rao, PHI Learning Private Limited, New Delhi, 2010
4. Food process engineering and technology. Zeki Berk, 1st edition, 2009, CRC Press, New York
5. Trends in Food Engineering. Jorge E. Lozano, Cristina Anon, Gustavo V. Barbosa-Canovas, Efren Parada-Arias, CRC Press; 1st Edition, 2000
6. Novel Food Processing Technologies (Food Science and Technology Series). Gustavo V. Barbosa-Canovas, Maria S. Tapia, M. Soledad Tapia, M. Pilar Cano, Publisher: CRC Press, 1st Edition, 2004
7. Minimal Processing Technologies in the Food Industry. Thomas Ohlsson and Nils Woodhead Publishing Limited, 1st Edition, 2002

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/104/126104004/
2. https://archive.nptel.ac.in/courses/126/104/126104004/
3. https://www.youtube.com/watch?v=iuW3nk5EADg
4. https://www.digimat.in/nptel/courses/video/126105015/L29.html
5. https://www.youtube.com/watch?v=Ut9uSlK-f-8

Activity Based Learning (Suggested Activities in Class)/ Practical Based learning

1. AV presentation by students (on topics as per choice of the teacher)
2. Online tools for surprise quizzes
3. Collection of case studies based on research findings
4. Model making and Poster presentations on specific case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Apply and evaluate irradiation and high pressure for food processing	L1, L2, L3, L4, L5
CO2	Apply and evaluate minimal methods for food processing	L1, L2, L3, L4, L5
CO3	Apply and evaluate heat for food processing applications	L1, L2, L3, L4, L5
CO4	Apply and evaluate ohmic and infrared heating for food processing	L1, L2, L3, L4, L5
CO5	Apply and evaluate extraction and hurdle technology for food processing	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems	1
2	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
3	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
4	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**		**2**	**3**								
CO2	**1**		**3**	**3**								
CO3	**1**		**2**	**3**								
CO4	**1**		**3**	**3**								
CO5	**1**		**2**	**3**	**1**							

Semester II

Grain Processing and Baking Technology (PEC-1)			
Course Code	22FDB231	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn structure and proximate composition of grains & physical properties
- To learn different technologies for making bakery products
- To learn roles of different components and technical considerations in different confectionary products
- To learn the strategies for chocolate and vanilla processing
- To learn the strategies for candy and toffee making

Module-1	
GRAIN PROCESSING AND MILLING I Classification of grains, cereal production and factors influencing the economics of production, structure and chemical composition of cereal grains (wheat, rice, corn, barley), Legumes, Oil seeds; Types of storage of cereals, Drying of cereals, Processing scenario of food grains (mortar and pestle, stone mill, French process, gradual reduction system, automatic mill), Dry and Wet milling, Dry milling of wheat- storage, cleaning, conditioning or tempering, milling (breaking, purification and reduction systems), Recent developments in flour milling	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
GRAIN PROCESSING AND MILLING II Dry milling of corn or maize (Roller milling), Decortication or Attrition milling-Barley pearling, Sorghum and millet decortication, Dry milling of paddy or rough rice, by products of dry rice milling, further processing of milled rice, Parboiling of rice or wet milling of rice (process, types, advantages and disadvantages), Rice grain quality indicators, Wet milling of maize, Dry and wet milling of pulses, extraction of oil from oilseeds, processing of vegetable oil	

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

BAKING TECHNOLOGY I

Leavening (Overview of biological and chemical leavening agents and products), Bread- quality of flour, overview of equipments used in bread making; bread making formulas and systems (straight dough, sponge dough, liquid sponge, short time bread making systems), Detailed process of straight dough bread making system- dough formation, fermentation, molding, proofing and baking; Bread staling, Other types of yeast leavened products (other breads, doughs, rusk-making process),

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4	
BAKING TECHNOLOGY II Chemical leavening and agents, Chemically Leavened products- Cookie types (rotary mold cookies, cutting machine cookies, wire cut cookies, sugar wafers), cookie flour quality, phenomena during cookie making process; Biscuits; Crackers (Saltine crackers-sponge fermentation, dough fermentation, dough processing, cracker baking; Snack crackers); Cakes (layer cakes-mixing, role of ingredients; angel food cakes; pound cakes)	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
PASTRY ANDCONFECTIONARY Pastry- types (short crust, flaky, puff, choux, phyllo, hot water crust pastries); Confectionary- classification of confectionary, Ingredients used in sugar confectionary, Technical considerations and production principles for confectionary products- TS, TSS, pH and acid content, ERH, sugar solubility, sugar crystallization, aeration, texture, etc.; Confectionary production process; traditional confectionary products; Candies and toffee manufacturing	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Principles of cereal science and technology. J.A. Delcour, R.C. Hoseney,
2. AACC International, 3rd edition, 2010
3. Food Technology-II. A. Patel, H.C. Devraja, P. Sharma, R. R. B. Singh, www.agrimoon.com, ICAR
4. Food Technology-I. A.K. Singh, P.N. Raju, A. Jana, www.agrimoon.com, ICAR
5. Bakery Products: science and technology. Y. H. Hui, H. Corke,
6. I.D. Leyn, WK Nip, N. Cross, Blackwell Publishing, 2006
7. Cereal grains for the food and beverage industries. E.K. Arendt, E. Zannini, Woodhead Publishing, 2013.
8. Cereals Processing Technology. G. Owens, CRC Press, Woodhead Publishing, 2001.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/104/126104004/
2. https://archive.nptel.ac.in/courses/126/104/126104004/
3. https://www.youtube.com/watch?v=iuW3nk5EADg
4. https://www.digimat.in/nptel/courses/video/126105015/L29.html
5. https://www.youtube.com/watch?v=Ut9uSlK-f-8

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand structure and chemical composition of grains & milling of grains	L1, L2, L3
CO2	Evaluate different milling technologies for selecting appropriate one for different grains	L1, L2, L3,L4,L5
CO3	Create strategies and processes for manufacturing yeast leavened bakery products	L1, L2, L3,L4,L5,L6
CO4	Create strategies and processes for manufacturing chemically leavened bakery products	L1, L2, L3,L4,L5,L6
CO5	Evaluate technical considerations and create strategies for manufacturing confectionary products	L1, L2, L3,L4,L5,L6

Program Outcome of this course

Sl. No.	Description	POs
1	Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	Problem analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3	Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3

4	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
5	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
6	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
7	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
8	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

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

Semester II

Food Packaging and Storage Engineering (PEC-1)			
Course Code	22FDB232	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To Learn packaging materials, packaging systems and food storage.
- To learn Application of packaging material used in food industry
- To learn the evaluation of suitability of appropriate storage system.
- To learn the modern packaging technology used in food industry

Module-1

INTRODUCTION:

Function of packaging, marketing consideration for a package and types of packaging. Barrier properties of packaging material, gas permeation rates- oxygen transmission rate (OTR), water vapour transmission rate (WVTR), bursting strength, tensile strength, tearing strength, drop test, puncture test, etc.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
Packaging materials: Selection of packaging materials, packaging machines and labeling Packaging materials for foods, Selection criteria of packaging materials for raw and processed food products. Machinery for Packaging: Form fill and seal machines, vacuum packaging machine, shrink wrap packaging machine and multilayer packaging system. Package labeling: functions, nutrition labeling, ingredient characterization handling instruction, and regulations; Shelf life of packaged food: water activity and prediction of shelf life. Packaging logistics.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
STORAGE ENGINEERING-I: Food Storage: Importance of scientific storage systems, postharvest Physiology of semi-perishables and perishables, climacteric and	

non-climacteric fruits, respiration, ripening, changes during ripening, ethylene biosynthesis. Product damages during storage. Storage structures: Traditional, improved and modern storage. Structures: farm silos. Stored grain management and aeration: moisture and temperature changes in stored grains; conditioning of environment inside. Storage, purposes of aeration, aeration theory and aeration system operation	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
STORAGE ENGINEERING-II: Storage pests and control: Damage due to storage insects, pests, rodents and its control. Storage of perishables: cold storage, controlled and modified atmospheric storage, hypoboric storage, evaporative cooling storage, conditions for storage of perishable products, control of temperature and relative humidity inside perishable storage.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
BIODEGRADABLE PACKAGING: Types of packaging, classification, advantages and limitations of each type of packaging, economics of various packaging materials; Specifications for packaging various food products, testing standards, testing agencies and biodegradability; Types of natural polymers used for developing food packaging, properties of natural polymers for food packaging applications, chemical modifications of natural polymers for food applications; Methods of manufacturing biodegradable packaging, testing and evaluation; Synthetic biopolymers used for packaging applications. Properties of the polymers and specifications; Methods of manufacturing synthetic polymer films, testing and evaluation.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Food Packaging: Principles and Practice. Gordon L. Robertson
2. Hand book of Postharvest Technology: Cereals

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. https://www.youtube.com/watch?v=gMabMSrLi60
3. https://archive.nptel.ac.in/courses/126/105/126105011/

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements in animal biotechnology and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To analyse the properties and functions of packaging material relevant for food packing	L1, L2, L3
CO2	To analyse properties and function of food items and apply in selection of packing material, labels, instruments and relevant testing	L1, L2, L3, L4, L6
CO3	To analyse the properties and functions of food products and apply for food storage	L1, L2, L3, L4
CO4	To analyse the properties and functions of food products and packing material relevant for pest control	L1, L2, L3, L4

CO5	To apply modern tools to design packaging material in food industry	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	3
2	**Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	4

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			**3**	**3**								
CO2			**3**	**3**								
CO3			**3**	**3**								
CO4			**3**	**3**								
CO5			**3**	**3**								

Semester II

Nutrigenomics (PEC-1)			
Course Code	22FDB233	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn of basic theory of these computational tools.
- To inculcate the fundamentals of informatics.
- To comprehend the applications of informatics in food research.
- To impart knowledge of various software tools used in nutrigenomic studies

Module-1

BIOLOGICAL DATABASES:

Introduction, Primary & Secondary database, Sequence file formats, Introduction to structures, Protein Data Bank (PDb), Molecular Modelling Database (MMDb), Structure file formats, Visualizing structural information, Database of structure viewers, Collection of sequences, sequence annotation, sequence description.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-2

SEQUENCE ALIGNMENT AND DATABASE SEARCHING: Evolutionary basis of sequence alignment, Optimal alignment methods, Substitution scores & gap penalties, Statistical significance of alignments, Database similarity searching, FASTA, BLAST, Low complexity regions, Repetitive elements, Multiple Sequence Alignment: Progressive alignment methods, Motifs and patterns, Clustral, Muscle; Scoring matrices, Distance matrices.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
PHYLOGENETIC ANALYSIS: Alignment, tree building and tree evaluation, Comparison and application of Unweighted Pair Group Method with Arithmetic Mean (UPGMA),Neighbour Joining (NJ), Maximum Parsimony (MP), Maximum Likelihood (ML) methods, Bootstrapping, Jackknife; Software for Phylogenetic analysis. DNA barcoding: Methods tools and databases for barcoding across all species, Applications and limitations of barcoding, Consortium for Barcode of Life (CBOL) recommendations, Barcode of Life Database (BOLD).	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
STRUCTURAL BIOLOGY: 3-D structure visualization and simulation, Basic concepts in molecular modeling: different types of computer representations of molecules; External coordinates and Internal Coordinates, Molecular Mechanics, Force fields etc. Secondary structure elucidation using Peptide bond, phi, psi and chi torsion angles, Ramachandran map, anatomy of proteins – Hierarchical organization of protein structure –like CATH (class, architecture, topology, homology), SCOP (Structural Classification of Proteins), FSSP (families of structurally similar proteins).	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
APPLICATIONS	

Classification and comparison of 3D structures DNA & RNA secondary and tertiary structures, t-RNA tertiary structure; Protein Secondary structure prediction: Algorithms viz. Chou Fasman, GOR methods, Tertiary Structure prediction: Fundamentals of the methods for 3D structure prediction (sequence similarity/identity of target proteins of known structure, fundamental principles of protein folding etc.) Homology/comparative modeling, fold recognition, threading approaches, and ab initio structure prediction methods; CASP (Critical Assessment of protein Structure Prediction); Computational design of promoters, proteins & enzymes.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. A.D. Baxevanis and B.F.F. Ouellette (Eds). (2002)
2. Jones & Peuzner, Introduction to Bioinformatics Algorithms; Ane Books, India. 200

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.swayam2.ac.in/cec21_ag07/preview
2. https://www.youtube.com/watch?v=90zr5v-A3B0
3. https://www.youtube.com/watch?v=3uXiu1AEi4M
4. https://extension.psu.edu/nutrigenomics

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements in animal biotechnology and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Detail the basic concepts in nutrigenomics.	L1, L2, L3, L4
CO2	Demonstrate the applications of informatics in food research.	L1, L2, L3, L4
CO3	Apply various software tools used in informatics for food processing and research problems	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
2	Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.	5
3	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
4	Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
5	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3	3	3						
CO2				3	3	3	3	3				
CO3				3	3	3	3	3				

Semester II

Plant based food products (PCC)			
Course Code	22FDB234	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn the importance of fruits, and vegetable processing in India.
- To learn different processing and preservation methods for fruits, and vegetable.
- To learn advanced methods of fruits, and vegetable processing.
- To apply acquired knowledge to evaluate different processing methods.
- To apply acquired knowledge to select appropriate method for processing of fruits and vegetables.

Module-1

POST-HARVEST HANDLING Production of Fruits and vegetables in India, Composition of major fruits and vegetables produced in the country, Post-harvest handling, transport and storage practices of fresh fruits and vegetables, Factors effecting for post-harvest losses. Production of milk in India, Composition of milk produced in the country, Post-harvest handling, transport and storage practices of milk, Factors effecting for post-harvest losses in milk during handling, transport and storage.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
FRUITS AND VEGETABLES PROCESSING Canning: Preparation of fruits and vegetables for canning – Washing, peeling, grating, slicing dicing, deseeding, blanching; Common machinery for operations, Juice and pulp extraction – extractors, Hydraulic Press, Hot and Cold Break process, Clarification, Clarification centrifuges, Decanters and desludgers; Fruit juice concentrates-methods of concentration, types of evaporators; Fruit Powders - Preparation of Fruit material for powder production, Process operations.	
Teaching-Learning Process	. Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint

	presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
FRUITS AND VEGETABLES PROCESSING Technology of Products: juices & pulps, concentrates & powders, squashes & cordials, nectars, fruit drinks & beverages carbonated and its quality control. Fermented products. Spices & condiments, spice oils oleoresins, Processing of cashew nuts, coffee & cocoa beans, and tealeaves, Specialty fruit and vegetable products	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	

ASPETIC AND OTHER PROCESSING METHODS Aseptic processing- Aseptic heat exchangers / pasteurizers, Aseptic fillers. Filling systems- Tetra pack for small quantities, Dole system and Scholle system for bulk filling; Hurdle technology with reference to Vegetable, Fruit and milk processing.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
NOVEL PROCESSING METHODS UV, High, Ultrasound, Membrane, High intensity pulsed electric field, ozone, Irradiation, Minimal processing, Storage in Modified Atmosphere, Active Packaging, Freeze concentration, Vacuum frying, Edible coatings.Principles and working of different types of bottle filters and capping machine, pouch filling machine, pre-pack and aseptic filling. Filling and Packaging machines.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

	Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Hand book of fruits and fruit processing. N.K.Sinha, J.S. Sidhu, J. Barta, J.S.B. Wu, M.P. Cano, Wiley-Blackwell, 2nd edition, 2012
2. Hand book of vegetables and vegetable processing. N.K.Sinha, Y. H. Hui,E. O.Evranuz, M. Siddiq, J. Ahmed, Wiley-Blackwell, 1st edition, 2011
3. Hand Book of Vegetable Preservation and Processing. Y. H. Hui, E. ÖzgülEvranuz, CRC Press, 2nd Edition, 2015
4. Fruit and Vegetable Preservation; Principles and Practices. R.P. Srivastava and Sanjeev Kumar, CBS; 3rd Edition, 2014
5. Technological Interventions In The Processing Of Fruits And Vegetables. RachnaSehrawat, Khursheed A. Khan, Megh R. Goyal, Apple Academic Press Inc. 2018

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc22_ag09/preview
2. https://archive.nptel.ac.in/courses/126/105/126105009/
3. https://onlinecourses.nptel.ac.in/noc22_ag13/preview
4. https://onlinecourses.nptel.ac.in/noc22_ag03/preview

Skill Development Activities Suggested

1. AV presentation by students (on topics as per choice of the teacher)
2. Online tools for surprise quizzes
3. Collection of case studies based on research findings
4. Model making and Poster presentations on specific case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Learn the importance of fruits, vegetable and milk processing in India.	L1, L2, L3
CO2	Learn different processing and preservation methods for fruits, vegetable and milk.	L1, L2, L3
CO3	Learn advanced methods of fruits, vegetable and milk processing.	L1, L2, L3
CO4	Apply acquired knowledge to evaluate different processing methods.	L1, L2, L3, L4
CO5	Apply acquired knowledge to select appropriate method for processing of fruits and vegetables.	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	**Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	1
2	**Problem analysis:** Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.	2
3	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
4	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
5	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
6	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**2**	**2**									
CO2	**2**	**2**	**2**									
CO3	**2**	**2**	**2**									
CO4						**3**	**3**	**3**				
CO5						**3**	**3**	**3**				

Semester II

Food Safety and Toxicology (PEC-1) (PEC-1)			
Course Code	22FDB235	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learnvariousfoodsafetyparametersandalsodifferenttoxicityissuesinfoodindustry.

- To learn theconceptoffoodingredients&additives.
- To learn thetoxicantsinfoods.

Module-1	
FOOD SAFETY: Types of food hazards: biological, chemical and physical; Risk assessment; Existing and emerging pathogens due to globalization of food trade; Newer systems of safety evaluation such as HACCP.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
FOOD TESTING: Testing of food ingredients & additives; Animal studies including LD50; Ames test for teratogenicity; Natural toxic constituents in plant foods; Shellfish poisoning	
Teaching-Learning	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint

Process	presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
DERIVED FOOD TOXICANTS: Chemicals from processing such as fumigants, chlorinated solvents, autoxidation products, carcinogens in smoked foods and pyrolysis, pesticides and herbicides. Toxicants generated during food processing and packaging such as nitrosamines, acrylamide, benzene, dioxins, furans etc. , persistent organic pollutants, food carcinogen and mutagens.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
DETERMINATION OF TOXICANTS IN FOODS: Biotransformation. Natural Toxins in Animal Foodstuffs. Natural Toxins in Plant Foodstuffs. Fungal Toxins Occurring in Foods. Toxic	

Food Contaminants from Industrial Wastes. Pesticide Residues in Foods. Food Additives. Toxicants Formed during Food Processing.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
FOOD TOXICITY: Intentional and unintentional additives; Toxicity due to microbial toxins including botulinum and staphylococcal toxins, mycotoxin and due to other food pathogens; Food allergy and intolerance; Detoxication strategy.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. S. S. Deshpande, (2002), Handbook of Food Toxicology. CRC Press.
2. Tannenbaum SR, (1979), Nutritional and Safety Aspects of Food Processing. Marcel Dekker Inc
3. Hobbs BC, Christian J.H.B. (1974), Microbiological Safety of Food. Academic Press Inc
4. Galli, C.L, (1978), Chemical Toxicology of Food. Elsevier-North- Holland Biomedical Press
5. Wallace Hayes, Claire L. Kruger, (2014), Hayes' Principles and Methods of Toxicology. CRC Press.
6. William Helferich, Karl Winter, (2001), Food Toxicology. CRC Press.
7. Cynthia A. Robert, (2009), The food Safety Information Handbook. Greenwood.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.swayam2.ac.in/cec20_ag06/preview
2. https://onlinecourses.swayam2.ac.in/nou19_ag07/preview
3. https://www.coursera.org/lecture/meat-we-eat/food-safety-RbZp1
4. https://www.youtube.com/watch?v=rNqFsZvICvk

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Able to understand various food safety parameters and also different toxicity issues in food industry.	L1, L2, L3,
CO2	Able to understand the concept of food ingredients & additives.	L1, L2, L3, L4
CO3	Able to understand toxicants in foods.	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions	4
2	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
3	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
4	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

5	**Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change	12

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3		2	2	2				2
CO2				3		2	2	2				2
CO3				3		2	2	2				2
CO4				3		2	2	2				2
CO5				3		2	2	2				2

Semester II

Dairy Technology (PEC-2)			
Course Code	22FDB241	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn milk processing and preservation.
- To learn principles of processing of milk and milk products.
- To learn advanced methods of milk processing.
- To learn the selection of appropriate method for milk processing.

Module-1

INTRODUCTION:

Understanding about milk, milk - composition, food and nutritive value, physico- chemical properties; milk reception at dairies, quality and quantity tests at reception. Equipments used in liquid milk processing.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
UNIT OPERATIONS IN MILK PROCESSING: Principles of milk processing: Filtration, milk storage, bulk cooling, stirring and mixing, standardization, pasteurization, sterilization,	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
PRODUCTION OF MILK PRODUCTS Drying of milk, principle and equipment: spray dryer, cyclone separator. Manufacturing of milk products and principles of processing of cheese, ice-cream, butter, special milk products, casein, whey, curd, butter milk etc. Equipment for indigenous milk products manufacturing. Enzymes and their role in the manufacture of dairy products.	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
NON-THERMAL PROCESSING AND PACKAGING: UV, High pressure, Ultrasound, Membrane, High intensity pulsed electric field applications in milk processing.Packaging: Filling Operations: Principles and working of different types of bottle filters and capping machine, pouch filling machine, pre-pack and aseptic filling. Filling and Packaging machines for milk and milk products, aseptic packaging	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
DAIRY PLANT MAINTENANCE:	

Bulk milk handling system, care and maintenance, Hygienic design concepts, sanitary pipes and fittings, CIP system. Preventive maintenance program for Dairy Plant, Maintenance organization, development of optimum organization planned overhaul and PERT planning, Utilities and sanitation in processing plant. By-product utilization from dairy industries.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Outlines of Dairy Technology. Sukumar De
2. Dairy Plant System and Layout. Tufail Ahmed
3. Engineering for Dairy and Food Products. A W Farrall. John Wiley and Sons
4. Indian Dairy Products. K S Rangappa
5. Milk and Milk Products. Clarence Henry Eckles
6. Cheese and Butter by V. Cheke and A. Sheeprd
7. Dairy Chemistry and Biochemistry. P. F. Fox
8. Dairy Technology: Principles of Milk Properties and Processes. P. Walstra.

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105013/
2. http://www.digimat.in/nptel/courses/video/126105013/L47.html
3. http://www.digimat.in/nptel/courses/video/126105013/L47.html
4. https://www.digimat.in/nptel/courses/video/126105013/L23.html

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Have clear vision about milk processing and preservation.	L1, L2,
CO2	Understand the principles of processing of milk and milk products	L3, L4, L5
CO3	Gain technical insights about advanced methods of milk processing.	L3, L4, L5
CO4	Evaluate different methods for the selection of appropriate method for milk processing.	L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	PO8

Mapping of COS and POs

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

Semester II

Fermentation Technology & Food Enzymes (PEC-2)			
Course Code	22FDB242	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn the basics , process and scope understand enzyme kinetics
- To learn the application of enzymes for food processing
- To learn different methods for enzyme purification
- To learn the production of enzymes by fermentation technology
- To learn the different fermentor designs relevant for food processing

Module-1

INTRODUCTION AND ENZYME KINETICS

Nature, Function, classification & nomenclature of enzymes, Specificity, Michaeli's Menton equation, Km, Lineweaver Berk Plot, Different inhibitors.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
FOOD RELATED ENZYMES AND APPLICATIONS Amylases, Pectic Enzymes, Proteases, Rennet; Oxidoreductases- Phenolases, Glucose Oxidases, Catalases, Peroxidases, Lipoxygenases, Xanthine Oxidases, Immobilized enzyme, Application of enzymes in food processing; Application of immobilized enzymes and cells.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
ENZYME PURIFICATION Ammonium sulphate precipitation, Gel exclusion chromatography, Ion exchange chromatography, Affinity chromatography- GST, His tag, Native PAGE, SDS-PAGE, Zymogram, Coomassie blue and Silver staining.	

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
FERMENTATION TECHNOLOGY Sterilization methods of Fermentors; Scale up and scale down; Biomass Production; Enzyme Production; Downstream processing.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
FERMENTORS Fermentor design and analysis; Aeration and Heat Transfer; Instrumentation and Control; Batch, Fed batch and continuous	

bioreactors.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Downstream Process Technology: A New Horizon In Biotechnology, Nooralabettu Krishna Prasad, PHI, 2012.
2. Enzyme technology: Pacemaker of Biotechnology, Nooralabettu Krishna Prasad, PHI, 2011
3. Biochemical Engineering Fundamentals. J.E. Baily and D.F. Ollis, Mcgraw Hill Chemical Engineering Series, 1st Edition, 1986
4. Industrial Microbiology. Samuel C Prescott and Cecil G Dunn, Agro bios (India), 2011
5. Principles of Fermentation Technology. P.F. Stanbury and A. Whitaker, Elsevier; 2nd Edition, 2008

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=ie9GIae--HU
2. https://www.digimat.in/nptel/courses/video/102102033/L01.html
3. http://www.digimat.in/nptel/courses/video/102105064/L29.html
4. https://archive.nptel.ac.in/courses/104/105/104105102/

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand enzyme kinetics	L1, L2, L3,
CO2	Evaluate the enzymes for food processing applications	L1, L2, L3, L4, L5
CO3	Analyze and evaluate different methods for enzyme purification	L1, L2, L3, L4
CO4	Create strategies for the production of enzymes by fermentation technology	L1, L2, L3, L4, L5, L6
CO5	Analyze and evaluate different fermentor designs	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1			3			2	2	2				
CO2				3		2	2	2				
CO3				3		2	2	2				
CO4				3		2	2	2				
CO5				3		2	2	2				

@# 03112023

Semester II

Nutraceuticals and Edible Vaccines (PEC-2)			
Course Code	22FDT243	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand the interrelationship between nutraceuticals and health maintenance.
- Cite the evidence supporting the efficacy and safety of nutraceutical and functional food products
- To explain the metabolic consequences of nutraceuticals and functional foods.
- Describe the physiologic and biochemical changes associated with consumption of nutraceuticals

Module-1

I**NTRODUCTION**

Nutraceuticals value of spices and seasoning –Turmeric, Mustard, Chilli, Cumin, Fenugreek, Black Cumin, Fennel, Asafoetidia, Garlic, Ginger, Onion, Clove, Cardamom etc., Nutraceuticals from Fruits And Vegetables –Mango,

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

	Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
STRUCTURE AND APPLICATION Omega -3 fatty acids from fish-Typical properties, structural formula, functional category. CLA-typical properties, structural formula, functional category. Application in Nutraceuticals. Calcium, chromium, copper, iodine, iron, magnesium, Zn-mechanism of action, bioavailability, uses and deficiency, dietary sources	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
TYPES AND CLASSIFICATION Definition, classification –Type of classification (Probiotics, probiotics and synbiotics: Taxonomy and important features of probiotic microorganisms. Health effects of probiotics including mechanism of action. Probiotics in various foods: fermented milk products, non-milk products etc. Prebiotics. Definition, chemistry, sources, metabolism and bioavailability, effect of processing, physiological effects, effects on human health and potential applications in risk reduction of diseases, perspective for food applications for the	

following: Non-digestible carbohydrates/oligosaccharides: Dietary fibre, Resistant starch, Gums.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
CLAIMS AND REGULATIONS Phytosterol, Fatty Acids, Carotenoids, Anthocyanins, Carotenoids, Amino Acids, Water Soluble Vitamins, Free radical biology and antioxidant activity of nutraceuticals. Regulations of Nutraceuticals and Functional Foods in India and rest of the world.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	

EDIBLE VACCINES Benefits, Limitations, Production, Techniques, Stable transformation, Transient transformation, Bombardment method, Additional methods, Immune response, Research, Vaccines in development, Animal testing	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Handbook of Nutraceuticals and Functional Foods. Yashwant Pathak, Vol. 1. (Ingredients, formulations, and applications) CRC Press 2005.

2.Handbook of Nutraceuticals and Functional Foods. Robert Wildman, 2ndEdition. CRC Press 2001.

Web links and Video Lectures (e-Resources):

1. https://www.classcentral.com/course/swayam
2. https://www.functionalfoodscenter.net/OnlineCourses.html
3. https://academy.nutrifytoday.com/
4. https://www.youtube.com/watch?v=gCeSLR5PFIc

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand various food ingredients and their functional properties	L1, L2,
CO2	Apply his understanding to select appropriate food for particular disease control.	L3, L4, L5
CO3	Understand and evaluate functional foods with respect to different regulations.	L3, L4, L5
CO4	Analyze the functional claims with respect to packaging and labelling	L3, L4, L5
CO5	Apply various regulations and laws imposed for functional food.	L3, L4,

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	PO3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	PO4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	PO6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	PO7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	PO8

Mapping of COS and POs

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

Semester II

Food Product Development (PEC-2)			
Course Code	22FDB244	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn the process of new product development.
- To learn the Analysis of the market for new product.
- To learn the Analysis of e availability and cost competitiveness for new products.
- To learn the evaluation of economics and commercialization of new product.
- To learn the evaluation process of control parameters during scale-up of product

Module-1

.Introduction: Need, importance and objectives of formulation for new product development. Ideas, business philosophy and strategy of new product.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
Formulation and Standardization: Formulation based on sources availability and cost competitiveness for concept developments of new products. Standardization of various formulation and product design	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
Product Development: Adaptable technology and sustainable technology for standardized formulation for process development. Process control parameters and scale-up, production trials for new product development at lab and pilot scale.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
.Quality and Market: Quality assessment of newly developed products- nutritional and sensory qualities, shelf-life and safety evaluation as per FSSAI guide lines. Market testing and marketing plan.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
Economical aspect: Costing and economic evaluation. Economics of food plant construction- estimation of economic plant size (breakeven analysis and optimization) & Estimation of volume of production for each product. Commercialization/ product launch.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations.

	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Food Product Development: Maximizing Success. R. Earle and A. Anderson
2. New Food Product Development: From Concept to Marketplace
3. Reference books:
4. Food Product Development: From Concept to the Marketplace. E. Graf and I. Saguy
5. Nutraceuticals Food Processing Technology: Innovative Scientific Research. Ed.R.P. Shukla
6. Food Science. B. Shrilakshmi
7. Food processing technology - principles and practice. P.J. Fellows
8. Industrial Economics: An Introductory Textbook. R.R. Barthwal

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. https://archive.nptel.ac.in/courses/112/107/112107217/

Skill Development Activities Suggested

1. AV presentation by students (on specific topics).
2. Discussion of case studies based on research findings.
3. Model making and Poster presentations

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand the process of new product development.	L1, L2, L3,
CO2	Analyze the market for new product	L1, L2, L3,
CO3	Analyze availability and cost competitiveness for new products	L1, L2, L3,
CO4	Evaluate economics and commercialization of new product	L1, L2, L3,
CO5	Evaluate process control parameters during scale-up of product	L1, L2, L3,

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**								
CO2				**3**								
CO3						**2**	**2**	**2**				
CO4						**2**	**2**	**2**				
CO5						**2**	**2**	**2**				

@# 03112023

Semester II

Food Industry Byproduct and Waste Management (PEC-2)			
Course Code	22FDB245	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn the uses of byproducts of dairy, fruit and vegetables related processing industries
- To lean the uses of byproducts of meat and fish processing units and agro based industries
- To learn the various laws and regulations of waste management and apply them for food processing industries.
- To learn different waste treatment methods for food processing industries
- To learn the strategies for the zero-discharge and zero-emission of waste

Module-1

BYPRODUCTS I

Various by-products from Food Processing Industry: By products of cereals, legumes, oil seeds, dairy, fruit and vegetables processing industries and their uses.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
BYPRODUCTS II By products of meat and fish processing units and their uses. Uses of by-products of agro based industries in various sectors.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
LAWS AND REGULATIONS Various laws and regulations for waste management in food processing industries.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
WASTE TREATMENT METHODS Food industry wastes, Waste treatment methods for Cereals, Fruits, vegetables, Meat, Fish, Dairy processing and Brewery Industries.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
WASTE WATER TREATMENT Preliminary treatment, primary, secondary, advanced and final treatment; zero-discharge and zero-emission system.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.

	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

9. Handbook of Waste Management and Co-Product Recovery in Food Processing. K. Waldron, Woodhead Publishing Limited, 1st Edition, 2007
10. Waste Management for the Food Industries. I.S. Arvanitoyannis, Academic Press, 2008
11. Utilization of By-Products and Treatment of Waste in the Food Industry. Vasso Oreopoulou and Winfried Russ, Springer US, 1st Edition, 2007
12. Food Science. Norman N. Potter and Joseph H. Hotchkiss, S. Chand Publication, 5th Edition, 2007
13. Food Processing By-Products and their Utilization, Ed. Anil K Anal, Willey Publication, 1st Edition, 2017

Web links and Video Lectures (e-Resources):

3. https://www.coursera.org/lecture/meat-we-eat/by-products-P51Cd
4. https://www.youtube.com/watch?v=bf-XC8Ko42I
5. https://www.youtube.com/watch?v=ikKFMgmqjOo

Skill Development Activities Suggested

4. NGS and Microarray data Analysis
5. Proteomic data network analysis.
6. AV presentation by students (on specific topics).
7. Discussion of case studies based on research findings.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Evaluate the uses of by-products of dairy, fruit and vegetables related processing industries	L1, L2, L3,
CO2	Evaluate the uses of by-products of meat and fish processing units and agro based industries	L1, L2, L3,
CO3	Analyze various laws and regulations of waste management and apply them for food processing industries.	L1, L2, L3,
CO4	Evaluate different waste treatment methods for food processing industries	L1, L2, L3,
CO5	Create strategies for the zero-discharge and zero-emission of waste	L1, L2, L3,

Program Outcome of this course

Sl. No.	Description	POs
1	**Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations	3
2	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	4
3	**The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.	6
4	**Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.	7
5	**Ethics: Apply** ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.	8

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				**3**								
CO2				**3**								
CO3						**2**	**2**	**2**				
CO4						**2**	**2**	**2**				
CO5						**2**	**2**	**2**				

@# 03112023

Semester II

Food Biotechnology Lab 2 (PCCL)			
Course Code	**22FDBL26**	CIE Marks	50
Teaching Hours/Week (L:T:P: S)	1:2:0	SEE Marks	50
Credits	2	Exam Hours	3

Course objectives:

- To learn the evaluation of food samples for organoleptic quality.
- To learn the evaluation of food samples for chemical and microbial safety.
- To determine physical properties of different food grains.
- To learn the Analysis of the data for the acceptability of food samples.
- To understand the usage of sophisticated instruments for various food applications.

Sl.NO	Experiments
1	Sensory evaluation of fruit juice and analysis of data by fuzzy logic and a method based on simple mathematical calculations (SMC)
2	Determination of protein concentration in food samples
3	Determination of reducing sugar concentration in food samples
4	Determination of nonreducing sugar concentration in food samples
5	Qualitative analysis of oils and fats
6	Determination of microbial counts in milk samples
7	Analysis of milk for quality

8	Analysis of milk for detection of adulterant
	Demonstration Experiments For CIE
9	Determination of BAR (Brix acid ratio) in beverages
10	Evaluation of food labels of products for PFA standards
11	Identification of food additives by using FTIR or GC or HPLC
12	Verification of packaging material by FTIR method

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

- Learn different food preservation methods.
- Evaluate the performance of different food processing equipment.
- Determine physical properties of different food grains.
- Analyse the energy and material balances of food processes

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each course. The student has to secure not less than 40% of maximum marks in the semester-end examination(SEE). In total of CIE and SEE student has to secure 50% maximum marks of the course.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.
- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8^{th} week of the semester and the second test shall be conducted after the 14^{th} week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.

Semester End Evaluation (SEE):

SEE marks for the practical course is 50 Marks.

SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University.

All laboratory experiments are to be included for practical examination.

(Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.

Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.

Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.

General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in -60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)

Change of experiment is allowed only once and 10% Marks allotted to the procedure part to be made zero.

The duration of SEE is 03 hours

Suggested Learning Resources:

1. Food Quality Control. M. Kalia, Agrotech Publishing Academy, 2010
2. Biochemical Methods. S. Sadasivamand A. Manickam, New Age International, 3rd Edition, 1996
3. Pearson's Composition and Analysis of Foods. Ronald S. Kirk and Ronald Sawyer, Addison-Wesley Longman Ltd, 1991
4. Quality Control for Food Industry. A Krammer, Vol. I and II, AVI Pub. Co., 3rd Edition, 1970
5. Handbook of Analysis and Quality Control of fruits & Vegetables Products. S Ranganna, Tata Mc Grow Hill Publications, 2nd Edition, 1986

Semester- I

BOS recommended ONLINE courses (AUD/AEC)			
Course Code	**22AUD27**	CIE Marks	Evaluation procedures are as per the policy of the online course providers.
Teaching Hours/Week (L:P:SDA)	Classes are as per the policy of the online course providers.	SEE Marks	
Total Hours of Pedagogy		Total Marks	
Credits	pp	Exam Hours	

1. Advanced Aquaculture Technology
2. Advanced Chemical Theory
3. Advanced Protein chemistry
4. Advanced Thermodynamics
5. An Introduction to Cardiovascular Fluid Mechanics
6. Animal Physiology
7. Applied Environmental Microbiology
8. Basic Principles and Calculations in Chemical Engineering
9. Bioenergetics of Life Processes
10. Bioenergy
11. Bioengineering : An Interface with Biology and Medicine
12. Biomedical nanotechnology
13. Biomicrofluidics

14.	Bioreactors
15.	Cell Culture Technologies
16.	Cellular biophysics: a framework for quantitative biology
17.	Computational Fluid Dynamics
18.	Computational Systems Biology
19.	Computer Aided Applied Single Objective Optimization
20.	Computer Aided Drug Design
21.	Conservation Geography
22.	Current regulatory requirements for conducting clinical trials in India for investigational new
23.	Dairy And Food Process And Products Technology
24.	Data Science for Engineers
25.	Descriptive Statistics with R Software
26.	Design Thinking - A Primer
27.	Design, Technology and Innovation
28.	Diary and food process and products technology
29.	Drug Delivery: Principles and Engineering
30.	drug/new drug (Version 2.0)
31.	Effective Engineering Teaching In Practice
32.	Electrochemical Technology in Pollution Control
33.	Electronic Waste Management - Issues And Challenges

34.	Employment Communication A Lab based course
35.	Energy Resources, Economics and Environment
36.	Entrepreneurship Essentials
37.	Environmental Biotechnology
38.	Environmental Quality Monitoring & Analysis
39.	Environmental Remediation of Contaminated Sites
40.	Equipment Design : Mechanical Aspects
41.	Essentials of Biomolecules : Nucleic Acids and Peptides
42.	Ethics in Engineering Practice
43.	Experimental Biotechnology
44.	Forest Biometry
45.	Forests and their management
46.	Functional Genomics
47.	Fundamentals Of Food Process Engineering
48.	Fundamentals Of Micro And Nanofabrication
49.	Fundamentals of Protein Chemistry
50.	Fundamentals of Spectroscopy
51.	Fuzzy Logic and Neural Networks
52.	General Microbiology
53.	Genetic Engineering: Theory and Application

54.	Genome Editing and Engineering
55.	Geographic Information System
56.	Health Research Fundamentals
57.	Human Behaviour
58.	Human Molecular Genetics
59.	Immunology
60.	Industrial Biotechnology
61.	Innovation by Design
62.	Instrumentation
63.	Intellectual Property
64.	Interactomics : Basics & Applications
65.	Introduction to Biomedical Imaging Systems
66.	Introduction to Biostatistics
67.	Introduction to Brain & Behaviour
68.	Introduction to Cell Biology
69.	Introduction to Cognitive Psychology
70.	Introduction to Developmental Biology
71.	Introduction to Dynamical Models in Biology
72.	Introduction to Environmental Economics
73.	Introduction to mechanobiology

74.	Introduction To Process Modelling In The Membrane Separation Process
75.	Introduction to Professional Scientific Communication
76.	Introduction to Proteogenomic
77.	Introduction To Proteomics
78.	Introductory Mathematical Methods for Biologists
79.	Manage TB
80.	Material and Energy Balances
81.	Matlab Programming for Numerical Computation
82.	Medical Biomaterials
83.	Medicinal Chemistry
84.	Membrane Technology
85.	Multiphase Flows
86.	Non-Conventional Energy Resources
87.	Offshore Structures Under Special Environmental Loads Including Fire Resistance
88.	Optical Spectroscopy and Microscopy : Fundamentals of optical measurements and
89.	Optimization in Chemical Engineering
90.	Organic farming for sustainable Agricultural production
91.	Patent Drafting for Beginners
92.	Patent Law for Engineers and Scientists
93.	Physics of Biological Systems

94.	Physics through Computational Thinking
95.	Plant Cell Bioprocessing
96.	Plastic Waste Management
97.	Post-Harvest Operations and Processing of Fruits, Vegetables, Spices and Plantation Crop Products
98.	Principles and Applications of NMR Spectroscopy
99.	Principles Of Downstream Techniques In Bioprocess
100.	Process Control - Design, Analysis and Assessment
101.	Product Design and Innovation
102.	Programming, Data Structures And Algorithms Using Python
103.	Protein folding
104.	Qualitative Research Methods and Research Writing
105.	Quantitative Methods in Chemistry
106.	Regulatory requirements for medical devices including in vitro diagnostics in India (Version
107.	Roadmap for patent creation
108.	Soft Nano Technology
109.	Strategic Performance Management
110.	The Joy of Computing using Python
111.	Thermal Processing of Foods
112.	Thermodynamics for Biological Systems : Classical and Statistical Aspect
113.	Tissue Engineering

114.	Transport Phenomena in Biological Systems
115.	Advanced Chemical Thermodynamics and Kinetics
116.	Ultrafast laser spectroscopy
117.	Understanding Design
118.	Waste to Energy Conversion

Semester III

Food Business Management and Entrepreneurship (PCC)			
Course Code	22FDB31	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn the fundamentals of project management and entrepreneurship development
- To learn the project formulation and market survey techniques
- To learn the network and project schedules
- To learn the project costs
- To learn the Learn launching and organizing of an enterprise

Module-1

INTRODUCTION

Introduction and definitions related with project management and entrepreneurship; Fundamentals of project managementand entrepreneurship development.

Teaching - Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
PROJECT FORMULATION: Market survey techniques, project identification, project selection, project proposal, work breakdown structure	
Teaching - Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
Network scheduling: Activity, networks, use of CPM, PERT in project scheduling. Resource planning, resource allocation, project scheduling withlimited resources	

Teaching - Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems.
	Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
BUSINESS Estimation of project costs, earned value analysis, project techno-economic viability, break-even analysis. Identification ofbusiness opportunity in food processing sector. Government policies for promotion of entrepreneurship in food processing.	
Teaching - Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	

ENTERPRISE Launching and organizing an enterprise, enterprise selection, market assessment, feasibility study, SWOT analysis, resourcemobilization. Financial institution in promoting entrepreneurship; Supply chain management	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

he weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ courseif the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks** to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined forthe course.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50. The question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. An Introduction to Business (v.1). Collins K. creativecommons.org, 2012 2.Economics and Management of the Food Industry. Jeffrey H. Dorfman, Routledge, 1st Edition, 2013
2. Food and Beverage Management. Partho Pratim Seal, Oxford University Press; 1st Edition, 2017
3. Food Industry: Food Processing and Management. Lisa Jordan, Callisto Reference, 2015
4. Fundamentals of Entrepreneurship. Nandan H., Prentice Hall India Learning Private Limited; 3rd Edition, 2013
5. Management in Engineering: Principles and Practice. Gail Freeman-Bell and James Balkwill, Prentice Hall, 1993
6. Operations Research: An Introduction. Hamdy A. Taha, Pearson Publication, 9th Edition, 2010
7. Project Management. K. Nagarajan, New Age International Pvt Ltd; 8th Edition, 2017

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=MO6EOMd-CkA
2. https://www.youtube.com/watch?v=eZgv1BW1lCU
3. https://www.youtube.com/watch?v=n6YIXmUEoYA
4. https://www.youtube.com/watch?v=64Z__faxcr0

Skill Development Activities Suggested

- Class Presentations and discussions of research articles from publications.
- Online tools for surprise quizzes.
- Collection of case studies via Newspapers/Journal articles, on topics covered.
- Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Le
CO1	Understand fundamentals of project management and entrepreneurship development	L1, L2, L3,
CO2	Understand project formulation and market survey techniques	L1, L2, L3,
CO3	Create network and project schedules	L1, L2, L3,
CO4	Evaluate project costs	L1, L2, L3,
CO5	Learn launching and organizing of an enterprise	L1, L2, L3,

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solvepractical problems.	PO 1
2	An ability to write and present a substantial technical report/document.	PO 2
3	Students should be able to demonstrate a degree of mastery over the area as per thespecialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO 3
4	Students should be able to acquire technical, research, managerial and entrepreneurial skillsrelated to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society.	PO 4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products.	PO 5

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5
CO1			**3**	**3**	
CO2			**3**	**3**	
CO3			**3**	**3**	
CO4			**3**	**3**	
CO5			**3**	**3**	

Semester III

Food Allergies and Allergens (PEC-3)			
Course Code	22FDB321	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand food allergies and allergens
- To understand Factors affecting food allergenicity
- To analyze Characteristics of food allergenictiy
- To Manage food allergenicity
- To evaluate Preventive measures for food allergies and Regulatory and labelling procedures

Module-1

INTRODUCTION

Introduction to food allergies and allergens: Overview of food allergies, allergens, immune system, antigen antibody interactions; sign & symptoms of food allergy; global prevalence of food allergies; classification of hypersensitivity reactions, use of bioinformatics in understanding and identification of potential cross allergens.

Teaching-Learning	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations.

Process	Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
Factors: food allergies and allergens Factors affecting food allergenicity, issues related to food additives and ingredients, genetic inheritance of food allergy,Immunological response, Oral allergy syndrome, GM foods and risk of allergy.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
Characteristics of food allergenicity Natural sources and chemistry of food allergens, handling of food allergies; Detection & Diagnostic techniques for allergy, limitationsof food allergy diagnostic techniques; Characterization of allergens, food sensitivities (anaphylactic reactions, metabolic food disorders and idiosyncratic reactions).	

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
Management of food allergenicity Principles of management of food allergens including detailed knowledge of avoidance measures; Application of Genetic modificationto reduce allergenicity; Methods used in safety evaluation-risk assessments	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	

Preventive measures for food allergies and Regulatory and labelling procedures: Prevention of allergic disease by primary, secondary and tertiary methods including aspects of epidemiology, hygiene and allergic march hypotheses; Case studies of reported food allergies and related food recalls. Hypoallergenic foods and dietary management of allergy, effect of processing treatments on food allergenicity; Regulatory procedures for food allergens at national and international level; Labelling guidelines.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

. The question paper will have ten full questions carrying equal marks.

. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Judy Owen, Jenni Punt, Sharon Stranford. (2013). Immunology by Kuby. 7th edition
2. S Flanagan. (2014). Handbook of Food Allergen Detection and Control, Simon Flanagan. 1st edition Woodheadpublishing .
3. Scott H. Sicherer. (2013). Food Allergy: Practical Diagnosis and Management. 1st edition CRC Press.
4. Ebisawa M. Sagamihara, Ballmer-Weber B.K. Zurich, Vieths S. Langen and Wood.
5. R.A. Baltimore, Md. (2015). Food Allergy: Molecular Basis and Clinical Practice. Karger Publishing.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/111107113
2. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
3. https://archive.nptel.ac.in/courses/126/105/126105015/
4. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level

CO1	understand food allergies and allergens	L1, L2, L3,
CO2	understand Factors affecting food allergenicity	L1, L2, L3,
CO3	analyze Characteristics of food allergenictiy	L1, L2, L3,L4
CO4	Manage food allergenicity	L1, L2, L3,L4,L5
CO5	evaluate Preventive measures for food allergies and Regulatory and labelling procedures	L1, L2, L3,L4,L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work tosolve practical problems	1
2	An ability to write and present a substantial technical report/document	2
3	Students should be able to demonstrate a degree of mastery over the area as per thespecialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	3
4	Students should be able to acquire technical, research, managerial and entrepreneurialskills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1				3	
CO2				3	
CO3	1			3	
CO4			2	3	
CO5			2	3	2

Semester III

Food additives and Preservatives (PEC-3)			
Course Code	22FDB322	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

1. Understand applications of food additives and how to study toxicity of food additives;
2. Understand various types and composition of food ingredients

Module-1

OVERVIEW:

Introduction to food additives and ingredients, their use in food processing, food product development and in food preservation, their functions and safety; Safety and quality evaluation of food additives and ingredients.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

Module-2

FOOD PRESERVATIVES:

Preservatives, antioxidants- chemistry, mechanism of action, properties and foodapplications.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

FOOD COLOURS, FOOD ADDITIVES (EMULSIFIERS, STABILIZERS AND SWEETENERS):

Colours, flavours- chemistry, properties, food applications. Emulsifiers, stabilizers, sweeteners- chemistry, mechanism of action, properties, food applications.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4

SEQUESTRANTS:

humectants and acidulants Sequestrants, humectants, acidulants - chemistry, mechanismof action, properties, food applications.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
FOOD INGREDIENTS: Ingredients- carbohydrate, protein, fat based and nutraceutical ingredients, theirproduction, properties and food applications	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

. The question paper will have ten full questions carrying equal marks.

. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Branen AL, Davidson PM; Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
2. Gerorge AB. (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
3. Gerorge AB. (2004). Fenaroli's Handbook of Flavor Ingredients. 5 th Ed. CRC Press.
4. Madhavi DL, Deshpande SS; Salunkhe DK. (1996). Food Antioxidants: Technological, Toxicologicaland Health Perspective. Marcel Dekker, New York.

Web links and Video Lectures (e-Resources):

1. https://onlinecourses.nptel.ac.in/noc23_ag18/preview
2. https://onlinecourses.swayam2.ac.in/cec19_ag01/preview
3. https://egyankosh.ac.in/bitstream/123456789/73121/1/Unit-7.pdf

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand applications of food additives and how to study toxicity of food additives;	L1, L2, L3,
CO2	Understand various types and composition of food ingredients	L1, L2, L3,
CO3	To identify various food colours and additives	L1, L2, L3,
CO4	To analyse the role of sequestrants	L1, L2, L3,
CO5	To apply the knowledge of various food ingradients in food sector	L1, L2, L3,

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	1
2	An ability to write and present a substantial technical report/document	2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	3
4	Students should be able to acquire technical, research, managerial and entrepreneurialskills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	4

5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1				**2**	
CO2				**2**	
CO3				**3**	
CO4			**1**	**2**	
CO5			**1**	**2**	

Semester –III

Automation in Food Processing (PEC-3)			
Course Code	22FDB323	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

1. To understand process control operations
2. To understand automation and robotics in Food Industry
3. To understand data acquisition
4. To apply modeling systems
5. To apply automation in food sector

Module-1

PROCESS CONTROL:

Introduction to process control, variables, strategies, laws Block and physical diagram of control systems, open and closed loop, feedback and forward controls pneumatic and electronic controllers. Measuring element controller and final control elements; P, PI, PID controls. Mode of control actions. PLC system; ladder diagram

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.
Module-2	
AUTOMATION AND ROBOTICS: Automatic process control in food industry. Process control methods in food industry, current, future trends. Robotics in food industry, specification of food sector robot.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
DATA ACQUISITION: Instrumentation in food processing, sensors for automation, measurement methods, applications, machine vision, optical sensors and spectroscopic techniques. SCADA; standards, application and implementation	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4

MODELING SYSTEMS:

Modeling strategy, ANN, null hypothesis, Intelligent control system using fuzzy logic, design of PID controller, real time optimization Food Contaminants from Industrial Wastes. Pesticide Residues in Foods. Food Additives. Toxicants Formed during Food Processing.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

Automation:

Automation in fruit, vegetables process. Automation in sorting, thermal processing, fresh produce: Automation in bulk sorting; principles, requirements. Automation in food chilling and freezing;in storage, transport, retail systems. Automation in fruit vegetable processing; cleaning, grading, canning etc.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

. The question paper will have ten full questions carrying equal marks.

. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Robotics and Automation in the Food Industry by D Caldwell, Elsevier Science, WoodheadPublishing.
2. Eackman DP. 1972. Automatic Process Control. Wiley Eastern.
3. George Stephanopolous, "Chemical Process Control", Prentice Hall of India, 1990.
4. Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.

Web links and Video Lectures (e-Resources):

5. https://nptel.ac.in/courses/111107113
6. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
7. https://archive.nptel.ac.in/courses/126/105/126105015/
8. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Program Outcome of this course

Sl. No.	Description	POs

1	An ability to independently carry out research /investigation and development work to solve practical problems	1
2	An ability to write and present a substantial technical report/document	2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	3
4	Students should be able to acquire technical, research, managerial and entrepreneurial skills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	5

Sl. No.	Description	Blooms Level
CO1	To understand process control operations	L1, L2, L3,
CO2	To understand automation and robotics in Food Industry	L1, L2, L3,
CO3	To understand data acquisition	L1, L2, L3,
CO4	To apply modeling systems	L1, L2, L3,
CO5	To apply automation in food sector	L1, L2, L3,

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1				**2**	

CO2				**2**	
CO3				**3**	
CO4			**1**	**2**	
CO5			**1**	**2**	

@# 03112023

Semester –III

Marine Food Products (PEC-3)			
Course Code	22FDT324	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To learn different methods of meat preservation
- To learn the evaluation on quality of meat
- To learn the abattoir design and poultry processing methods
- To learn the evaluation of unit operations for poultry and fish products
- To learn the evaluation of different methods of processing of marine products

Module-1

AT:

nposition from different sources; Muscle structure and composition; Postmortem musclechemistry; Meat colour and flavours; Meat microbiology and safety; Modern abattoirs, Stunning methods.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-2

SLAUGHTERING AND DRESSING:

Steps in slaughtering and dressing; Operational factors affecting meatquality; effects of processing on meat tenderization; Halal, jhatka and kosher meat processing.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

CHILLING AND FREEZING:

Carcass and meat, Cold storage, freezing and preservation. Canning, cooking, drying, pickling, curing and smoking; Prepared meat products salami, kebabs, sausages, sliced, minced, corned.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
JLTRY INDUSTRY IN INDIA: robiology of poultry meat; Spoilage factors; Layout, sanitation and processing operations of poultry processing. Byproducts: eggs, egg products; Whole egg powder and egg yolk products: manufacture, packaging and storage.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	

Fish: structure and composition, post mortem changes, rigor mortis, autolytic changes, bacteriological changes, rancidity, physical changes. Meat plant hygiene: GAP and HACCP; Packaging of meat products, Packaging of poultry products, refrigerated storage of poultry meat. . Types of fish, composition, structure, post-mortem changes in fish. Handling of fresh water fish. Canning, smoking, freezing and dehydration of fish. Fish sausage and home making. MMPO, MFPO, radiation processing meat safety. **CASE STUDIES:** Safety and sanitation in meat processing industry	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Lawrie's Meat Science. Fidel Toldra, Woodhead Publishing, 8th Edition, 2007
2. Egg Science and Technology. W.J. Stadelmen and O.J. Cotterill, CRC Press, 4th Edition, 1995
3. Handbook of Meat Processing. Ed. Fidel Toldrá, Blackwell Publishing, 1st Edition, 2010
4. Marine and Freshwater Products Handbook, Roy E. Martin, Emily Paine Carter, George J. Flick, Jr., Lynn M. Davis, CRCPress, 1st Edition, 2000
5. Meat Handbook. A. Lavie, AVI, Westport, 4th Edition, 1980
6. Food Science. Norman N. Potter and Joseph H. Hotchkiss, S. Chand Publication, 5th Edition, 2007
7. Meat Products Handbook. G Feiner, Woodhead Publishing, 1st Edition, 2006
8. Muscle as Food. P.J. Bechtel, Academic Press, 1st Edition, 1986

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=9h7Q62thXGg
- https://www.youtube.com/watch?v=At8iNR38rfo
- https://www.youtube.com/watch?v=irnVa3Bn7_w
- https://www.youtube.com/watch?v=l8AT48eIFQw

Skill Development Activities Suggested

- Class Presentations and discussions of research articles from publications.
- Online tools for surprise quizzes.
- Collection of case studies via Newspapers/Journal articles, on topics covered.
- Group discussions on recent advancements and case studies

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Evaluate different methods of meat preservation	L1, L2, L3, L4, L5
CO2	Evaluate quality of meat	L1, L2, L3, L4, L5
CO3	Analyze abattoir design and evaluate poultry processing methods	L1, L2, L3, L4
CO4	Evaluate unit operations for poultry and fish products	L1, L2, L3, , L4, L5
CO5	Evaluate different methods of processing of marine products	L1, L2, L3, , L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practicalproblems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3

4	Students should be able to acquire technical, research, managerial and entrepreneurial skills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	PO4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	PO5

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5
CO1				**3**	
CO2				**2**	**3**
CO3				**3**	
CO4				**3**	
CO5				**3**	

Semester –III

Post Harvest Technology (PEC-3)			
Course Code	22FDB325	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

1. To identify the physiology changes and their reasons occurring after fruit and vegetable harvestand methods for quality improvement.
2. To apply the knowledge of factors affecting post-harvest physiology.
3. To apply the knowledge Quality Improvement techniques in Food industries.

Module-1

INTRODUCTION:

Basic post harvest physiology, definition, respiration and gas exchange, hormonal changes during post harvest, physical and chemical changes, transpiration, water stress.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used.

Module-2

FACTORS AFFECTING POST-HARVEST PHYSIOLOGY: Pre-harvest nutritional factors, harvesting and handling injuries, storage conditions; temperature, RH, composition and its modification, ethylene biosynthesis and action	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	
CHANGES DURING HANDLING AND STORAGE: Changes during ripening, hormones, enzymes associated, change in colour, texture, flavour during storage, role of vitamins and carbohydrates. Maturity and maturity indices, storage types, post- harvest treatments, bio regulators	
Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.
Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	

FACTORS INVOLVED WITH SPOILAGE: Biotic, abiotic factors; temperature, insects, microbes; fungi, bacteriaetc. quality and safety factors,	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
QUALITY IMPROVEMENT TECHNIQUES: Improve quality; harvesting, handling techniques, coatings and treatments, insect control and microbial control, quality control measures, GAP, GMP, HACCP. STORAGE CHARACTERISTICS: Storage characteristics of different fruits and vegetables, measurement of product quality methods; destructive and non- destructive tests; physical chemical, biological, visual methods.	

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

. The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.

. The question paper will have ten full questions carrying equal marks.

. Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

. Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Robotics and Automation in the Food Industry by D Caldwell, Elsevier Science, WoodheadPublishing.
2. Eackman DP. 1972. Automatic Process Control. Wiley Eastern.
3. George Stephanopolous, "Chemical Process Control", Prentice Hall of India, 1990.
4. Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/111107113
2. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
3. https://archive.nptel.ac.in/courses/126/105/126105015/
4. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	To identify the physiology changes and their reasons occurring after fruit and vegetable harvestand methods for quality improvement.	L1, L2, L3,
CO2	To apply the knowledge of factors affecting post-harvest physiology.	L1, L2, L3,
CO3	To apply the knowledge of changes during handling and storage of food products	L1, L2, L3,
CO4	To identify and apply the factors involved in food spoilage	L1, L2, L3,
CO5	To apply the knowledge Quality Improvement techniques in Food industries.	L1, L2, L3,

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	1
2	An ability to write and present a substantial technical report/document	2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	3
4	Students should be able to acquire technical, research, managerial and entrepreneurial skills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	4

5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	5

Mapping of COS and PoS

	PO1	PO2	PO3	PO4	PO5
CO1				**2**	
CO2				**2**	
CO3				**3**	
CO4			**1**	**2**	
CO5			**1**	**2**	

Semester III

Fruit, Vegetable, and Milk process technology (PEC-4)			
Course Code	22FDB331	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

1. To learn the importance of fruits, vegetable and milk processing in India.
2. To learn different processing and preservation methods for fruits, vegetable and milk.
3. To learn different methods of milk processing.
4. To apply acquired knowledge to evaluate different processing methods.
5. To apply acquired knowledge to select appropriate method for processing of fruits and vegetables.

Module-1

POST-HARVEST HANDLING

Production of Fruits and vegetables in India, Composition of major fruits and vegetables produced in the country, Post-harvest handling, transport and storage practices of fresh fruits and vegetables, Factors effecting for post-harvest losses. Production of milk in India, Composition of milk produced in the country, Post-harvest handling, transport and storage practices of milk, Factors effecting for post-harvest losses in milk during handling, transport and storage.

Teaching-Learning	Include traditional teaching learning process such as Chalk and Talk using writing boards.

Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-2

FRUITS AND VEGETABLES PROCESSING

Canning: Preparation of fruits and vegetables for canning – Washing, peeling, grating, slicing dicing, deseeding, blanching; Common machinery for operations, Juice and pulp extraction – extractors, Hydraulic Press, Hot and Cold Break process, Clarification, Clarification centrifuges, Decanters and desludgers; Fruit juice concentrates-methods of concentration, types of evaporators; Fruit Powders - Preparation of Fruit material for powder production, Process operations.

Teaching-LearningProcess	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

MILK AND MILK PRODUCT PROCESSING:

Filtration, milk storage, bulk cooling, stirring and mixing, standardization, pasteurization, sterilization, centrifugation, homogenization,evaporation and condensation. Manufacturing of milk products and principles of processing of cheese, ice- cream, butter, milk powder, casein, whey, curd, butter milk etc.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4

ASPETIC AND OTHER PROCESSING METHODS

Aseptic processing- Aseptic heat exchangers / homogenizers, Aseptic fillers. Filling systems- Tetra pack for small quantities, Dolesystem and Scholle system for bulk filling; Hurdle technology with reference to Vegetable, Fruit and Milk processing.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

NOVEL PROCESSING METHODS

UV, High pressure processing, Ultrasound, Membrane, High intensity pulsed electric field, ozone, Irradiation, Minimal processing, Storage in Modified Atmosphere, Active Packaging, Freeze concentration, Vacuum frying, Edible coatings, Ohmic heating, Microwavedielectric heating technology

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Hand book of fruits and fruit processing. N.K.Sinha, J.S. Sidhu, J. Barta, J.S.B. Wu, M.P. Cano, Wiley-Blackwell, 2nd edition, 2012
2. Hand book of vegetables and vegetable processing. N.K.Sinha, Y. H. Hui,E. O.Evranuz, M. Siddiq, J. Ahmed, Wiley-Blackwell, 1st edition, 2011
3. Hand Book of Vegetable Preservation and Processing. Y. H. Hui, E. ÖzgülEvranuz, CRC Press, 2nd Edition, 2015
4. Fruit and Vegetable Preservation; Principles and Practices. R.P. Srivastava and Sanjeev Kumar, CBS; 3rd Edition, 2014
5. Technological Interventions In The Processing Of Fruits And Vegetables. RachnaSehrawat, Khursheed A. Khan, Megh R. Goyal, Apple Academic Press Inc. 2018
6. Outlines of Dairy Technology. Sukumar De, Oxford University Press, 5th Edition, 2005
7. Dairy Plant System and Layout. Tufail Ahmed, Kitab Mahal, New Delhi, 1996
8. Milk processing and quality management. A.Y.Tamime, Wiley- Blackwell, West Sussex, UK,2009
9. Dairy Technology: Principles of Milk Properties and Processes. P. Walstra, T.J. Geurts, A. Noomen, A. Jellema, M.A.J.S. van Boekel, 1st Edition, Marcel Dekker, New York ,1999
1. Dairy science and technology hand book- Principles and properties. Y.H. Hui, Wiley-VCH, New York, 1993

Web links and Video Lectures (e-Resources):

1. https://archive.nptel.ac.in/courses/126/105/126105015/
2. https://archive.nptel.ac.in/courses/126/105/126105015/
3. https://archive.nptel.ac.in/courses/126/105/126105015/

Skill Development Activities Suggested

- Demos on basic fermentation process and separation techniques.
- AV presentation by students (on topics as per choice of the teacher)
- Online tools for surprise quizzes
- Collection of case studies based on research findings
- Model making and Poster presentations on specific case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

Sl. No.	Description	Blooms Level
CO1	Learn the importance of fruits, vegetable and milk processing in India.	L1, L2, L3
CO2	Learn different processing and preservation methods for fruits, vegetable and milk.	L1, L2, L3
CO3	Learn advanced methods of fruits, vegetable and milk processing.	L1, L2, L3
CO4	Apply acquired knowledge to evaluate different processing methods.	L1, L2, L3, L4
CO5	Apply acquired knowledge to select appropriate method for processing of fruits and vegetables.	L1, L2, L3, L4

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems.	PO 1

	2	An ability to write and present a substantial technical report/document.	PO 2	
	3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.	PO 3	
	4	Students should be able to acquire technical, research, managerial and entrepreneurial skills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society.	PO 4	
	5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products.	PO 5	

Mapping of COS and POS

	PO1	PO2	PO3	PO4	PO5
CO1			3		
CO2			3		
CO3			3	2	
CO4			3		
CO5			3		

Semester III

Nanotechnology in food industry (PEC-4)			
Course Code	22FDB332	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand nanotechnology for improving food quality and detection of contaminants
- To understand nano ingredients and additives
- To apply Nanotechnology in Agriculture and Food Technology fields
- To apply Nano technology in packaging
- To evaluate the risks associated with nanotechnology

Module-1

Introduction

Definition of nanotechnology, development, application of nanoscale materials, AFM, natural food nano substances andnanostructure – carbohydrate, protein, emulsion. Nanotechnology fo improving food quality, detection of contaminants

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve food technology problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
Nano Ingredients and additives Nano Ingredients and additives: Nano materials for food applications- metal oxides, functionalized nanomaterials, nano additives,relation to digestion	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve food technology problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	

Nanotechnology in Agriculture and Food Technology Nanotechnology in Agriculture and Food Technology Nanotechnology in Agriculture - Precision farming, Smart delivery system Nanofertilizers: Nanourea and mixed fertilizers, Nanofertigation Nanopesticides, Nanoseed Science. Nanotechnology in Food industry Nanopackaging for enhanced shelf life - Smart/Intelligent packaging - Food processing and food safety and bio-security – Electrochemical sensors for food analysis and contaminant detection.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve food technology problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
Nano technology in packaging Nano technology in packaging: Nano technology in food packaging, nano composites, nano coatings. Role in active packaging,intelligent packaging. Nano sensor. Nano membrane Potential Benefits and hazards. Industrial benefits, consumer benefits, Detection and characterization of nanoparticles in food, exposure, potential hazards	

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve food technology problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.
Module-5	
Risks associated with nanotechnology Risks associated ENP, health risks- toxins, metabolism action etc. Risk governance- principle Regulations. General regulations, safetyaspects in different regions, Regulation aspects of nano scale food ingredients, additives, FCMS.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve food technology problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. P. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead publication, London, 2006.
2. J. Altmann, Routledge, Military Nanotechnology: Potential Applications and Preventive Arms Control, Taylor and FrancisGroup, 2006.
3. Introduction to nanotechnology - Charles P. Poole; Frank J. Owens – 2008 – Wiley.
4. Nanotechnologies in Food – Qasim Chaudhary, Laurence Castle, Richard Watkins - 2010- RSC Publishing
5. P. J. Brown and K. Stevens, Nanofibers and Nanotechnology in Textiles, Woodhead Publishing Limited, Cambridge, (2007).
6. Q. Huang -Nanotechnology in the Food, Beverage and Nutraceutical Industries. Woodhead Publishing 2. Limited - 2010
7. Lestie prey, “Nanotech in food products”, Wiley publications 2010.
8. Pandua W., “Nanotech research methods for foods and bioproducts”, Wiley publications 2012.

Web links and Video Lectures (e-Resources):

1. https://nptel.ac.in/courses/111107113
2. https://archive.nptel.ac.in/courses/102/106/102106051/ https://onlinecourses.nptel.ac.in/noc22_ma20/preview
3. https://archive.nptel.ac.in/courses/126/105/126105015/
4. https://onlinecourses.nptel.ac.in/noc22_ma33/preview

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

t the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand nanotechnology for improving food quality and detection of contaminants	L1, L2, L3,
CO2	Understand nano ingredients and additives	L1, L2, L3,
CO3	Apply Nanotechnology in Agriculture and Food Technology fields	L1, L2, L3,
CO4	Apply Nano technology in packaging	L1, L2, L3,
CO5	Evaluate the risks associated with nanotechnology	L1, L2, L3,L4,L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work tosolve practical problems	1
2	An ability to write and present a substantial technical report/document	2

3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	3	
4	Students should be able to acquire technical, research, managerial and entrepreneurialskills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	4	
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	5	

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5
CO1				**3**	**2**
CO2				**3**	
CO3				**3**	
CO4				**3**	
CO5			**2**	**3**	

Water and Beverage Technology (PEC-4)			
Course Code	22FDB333	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand manufacturing technology for juice-based beverages and synthetic beverages.
- To evaluate the manufacturing and quality of non-alcoholic beverages
- To evaluate the manufacturing and quality of alcoholic beverages
- To analyze impurities in water for its purification and treatment
- To evaluate the manufacturing and quality of packaged drinking water

Module-1

INTRODUCTION

Types of beverages and their importance; status of beverage industry in India; Manufacturing technology for juice-based beverages;synthetic beverages.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
NON-ALCOHOLIC BEVERAGES Ingredients for beverage preparations, role of various ingredients of soft drinks, carbonation of soft drinks. Technology of still, carbonated, low-calorie and dry beverages; isotonic and sports drinks. Specialty beverages based on tea, coffee, cocoa, spices, plant extracts, herbs, nuts, dairy and limitation of dairy-based beverages.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	

ALCOHOLIC BEVERAGES Brewing technology; Alcoholic beverages- types- fermented beverages (beer and wines) & distilled beverages (Cane sugar, sugar beet,honey, fruit, grain based, herbal, plant, seed, tree, vegetable distillations & complex/multiple distillations), manufacture and quality evaluation; the role of yeast in beer and other alcoholic beverages, ale type beer, lager type beer, equipment used for brewing and distillation.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-4	
WATER Water chemistry, water activity, water purification and treatment, Impurities in water and its analysis.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

WATER – PACKAGING AND QUALITY Packaged drinking water- definition, types, manufacturing processes, quality evaluation and raw and processed water, methods ofwater treatment, BIS quality standards of bottled water; mineral water, natural spring water, flavoured water, carbonated water.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Food Product Development: Maximizing Success. R. Earle and A. Anderson, Woodhead Publishing Series in FoodScience, Technology and Nutrition, CRC Press; 1st Edition, 2001
2. New Food Product Development: From Concept to Marketplace, Gordon W. Fuller, CRC Press, 3rd Edition, 2011
3. Food Product Development: From Concept to the Marketplace. E. Graf and I. Saguy, Springer US, 1st Edition, 1991
4. Nutraceuticals Food Processing Technology: Innovative Scientific Research. Ed. R.P. Shukla, R.S. Mishra, Abhishek DuttTripathi, Ashok Kumar Yadav, Manju Tiwari, Raghvendra Raman Mishra, Bharti Publications; 1st Edition, 2017
5. Food Science. B. Shrilakshmi, New Age International (P) Limited Publication, 3rd Edition, 2003
6. Food processing technology - principles and practice. P.J. Fellows, CRC press, 3rd edition, 2009
7. Industrial Economics: An Introductory Textbook. R.R. Barthwal, New Age Publication, 1st Edition, 2010

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=O-MRC0dskHg
- https://www.youtube.com/watch?v=rKn0NuUpRf0
- https://www.youtube.com/watch?v=UhwjbPprwX0
- https://www.youtube.com/watch?v=Q_MZkOCdUzc

Skill Development Activities Suggested

- Class Presentations and discussions of research articles from publications.
- Online tools for surprise quizzes.
- Collection of case studies via Newspapers/Journal articles, on topics covered.
- Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand manufacturing technology for juice-based beverages and synthetic beverages.	L1, L2, L3,
CO2	Evaluate the manufacturing and quality of non-alcoholic beverages	L1, L2, L3, L4
CO3	Evaluate the manufacturing and quality of alcoholic beverages	L1, L2, L3, L4, L5
CO4	Analyze impurities in water for its purification and treatment	L1, L2, L3, L4
CO5	Evaluate the manufacturing and quality of packaged drinking water	L1, L2, L3, L4, L5

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in	PO3

	the appropriate bachelor program	
4	Students should be able to acquire technical, research, managerial and entrepreneurial skills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	PO4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	PO5

Mapping of COS and Pos

	PO1	PO2	PO3	PO4	PO5
CO1			**3**		
CO2				**3**	
CO3				**3**	
CO4				**3**	
CO5				**3**	

Plantation Products and Spices Technology (PEC-4)			
Course Code	22FDB334	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand different types of spices and their importance.
- To understand the methods of processing of different spices & dry fruits.
- To understand and create strategies for processing of tea leaves to obtain different kinds of tea
- To understand the processing of coffee to obtain different kinds of coffee
- To understand and create strategies for processing of cocoa bean to obtain different products of cocoa

Module-1

INTRODUCTION

Classification, composition, structure and characteristics. Production status of spices in India: major spice producing area in India andworldwide, export potential of processed and raw spice product

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-2

SPICE AND DRY FRUIT PROCESSING

Processing of major and minor spices: Preservation and processing of major and minor spices of India; Processing of whole spice, spice powder, paste and extracts; production and processing of spice mixtures; spice oils and oleoresins, functional role of spices, quality specification for spices Composition, Structure, characteristics & processing of cashew nut and other dry fruits.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-3

TEA PROCESSING

Composition and production of tea leaves; processing of tea leaves; CTC tea, black tea, green tea and Oolong tea, grading and packaging;

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or Power Point presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4

COFFEE PROCESSING

Production and processing of coffee cherries by wet and dry method; processing technology for coffee; preparation of brew; processing technology for instant coffee and decaffeinated coffee; Nitrous coffee; Specialty coffee, Introduction to coffeecupping/tasting.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

COCOA PROCESSING

Cocoa bean-introduction, history and composition; processing of cocoa bean; processed products of cocoa such as cocoa powder,cocoa liquor, chocolate manufacturing.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. The complete book on cultivation and manufacture of tea. Panda H, 2nd revised edition, Asia Pacific Business Press Inc., NIIR
2. Coffee-growing, processing, sustainable production. Wintgens J.N., Wiley- VCH, 2004.
3. Cocoa production and processing technology. Afoakwa EO. Taylor and Francis group, 2014
4. Handbook on Spices and Condiments (Cultivation, Processing and Extraction).Panda H. Asia Pacific Business Press Inc., NIIR,2010
5. Small-scale cashew nut processing. Azam-Ali S.H. and Judge E.C. FAO, 2001
6. Vanilla-post harvest operations. InPho-Post harvest compendium. Javier De La Cruz Medina , Guadalupe C. RodriguezJiménes, and Hugo S. García. FAO, 2009

Web links and Video Lectures (e-Resources):

1. http://ecoursesonline.iasri.res.in/course/view.php?id=156
2. https://onlinecourses.nptel.ac.in/noc22_ag13/preview
3. https://www.youtube.com/watch?v=x-m3SnyURa8
4. https://www.youtube.com/watch?v=0eBEmkB3tyE

Skill Development Activities Suggested

1. Coffee Brewing via different methods/machines
2. Coffee cupping/Tasting
3. Preparation of Tea variants
4. Spice powder/paste/sauce preparation

Course Outcomes

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand different types of spices and their importance	L1, L2
CO2	Understand the methods of processing of different spices & dry fruits	L3, L4
CO3	Understand and create strategies for processing of tea leaves to obtain different kinds of tea	L3, L4, L5, L6
CO4	Understand the processing of coffee to obtain different kinds of coffee	L3, L4, L5, L6
CO5	Understand and create strategies for processing of cocoa bean to obtain different products of cocoa	L3, L4, L5, L6

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2
3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	Students should be able to acquire technical, research, managerial and entrepreneurialskills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	PO4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	PO5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1			3		
CO2			3	2	
CO3			3	3	
CO4			3	3	
CO5			3	3	

Agricultural Biotechnology (PEC-4)			
Course Code	22FDB335	CIE Marks	50
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	50
Total Hours of Pedagogy	3	Total Marks	100
Credits	3	Exam Hours	3

Course Learning objectives:

- To understand conventional crop improvement programs and the role agricultural biotechnology in food security andnational economy
- To apply biotechnological approaches for crop improvement
- To apply plant tissue cultural methods for crop improvement
- To evaluate uses of antisense RNA technology and biotechnology in agriculture
- To evaluate legal and socioeconomic impacts of biotechnology

Module-1

INTRODUCTION

Staple food, fiber, fuel and fruit crops of India and abroad, Agro-climatic zones and cropping pattern of India. Conventional crop improvement programs- Introduction, Selection and Hybridization, Mutation, Haploidy and Polyploidy Breeding. Modern agriculturebiotechnology for food security and national economy. Green-revolution.

Teaching-	Include traditional teaching learning process such as Chalk and Talk using writing boards.
Learning Process	Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems. Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-2	
APPLICATIONS OF BIOTECHNOLOGY IN AGRICULTURE Productivity and performance, disease resistance, genes and gene constructs used for viral resistance by coat protein mediated production, bacterial resistance by lysozyme gene and fungal resistance by chitinase and beta glucanase genes. Agrobacterium mediated tranformation. Crop improvement to resist adverse soil conditions. Salinity tolerance, drought resistance. Herbicide resistance in commercially important plants. Insecticide resistance through BT-gene.Integrated pest management. current status of BT crops in the world. Effect of transgenic crops on environment.	
Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work
Module-3	

PLANT TISSUE CULTURE

Explant selection, sterilization and inoculation; Various media preparations; MS, B5, SH PC L-2; Callus and cell suspension culture; plant regeneration-organogenesis, somatic embryogenesis; somaclonal variation, its genetic basis and application in crop improvement. Role of tissue culture in rapid clonal propagation, production of pathogen free plants and "synthetic seeds"; haploid production: advantages and methods. Protoplast technology.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Module-4

ANTISENSE RNA TECHNOLOGY AND BIOTECHNOLOGICAL APPLICATIONS IN AGRICULTURE

Antisense RNA technology (ACC synthase gene and polygalacturonase): Delay of softening and ripening of fleshy fruits by antisense RNA for ACC synthase gene in tomato and banana. Use of antisense RNA technology for extending shelf life of fruits and flowers. Protection of cereals, millets and pulses following harvest using biotechnology. Biotechnology for fortification of agricultural products-Golden rice, transgenic sweet potatoes. Importance of biofertlilizers in agriculture: (Rhizobium azatobacter, Mycorrhiza, Frankia and Blue green algae) current practices and production of biofertilizers.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPoint presentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work.

Module-5

AN OVERVIEW OF LEGAL AND SOCIOECONOMIC IMPACT OF BIOTECHNOLOGY

Biotechnology & hunger. Ethical issues associated with labeling and consumption of GM foods. Public perception of GM technology. Biosafety management. Cartagena protocol on biosafety. Ethical implication of BT products, public education, Biosafety regulations,experimental protocol approvals, guidelines for research, environmental aspects of BT applications.

Teaching-Learning Process	Include traditional teaching learning process such as Chalk and Talk using writing boards. Construct graphical and pictorial representation of the subject in the form of Chart, hand-outs or PowerPointpresentations. Collaborate with students how tools are applied to solve biological problems.Integrate real time case studies in various scientific tools used. Reflective approaches on analysing how and why the tools are used in self-reflected or published data. Incorporate Inquiry based approach using demonstration, field study, experiments and project work

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 50% of the maximum marks. Minimum passing marks in SEE is 40% of the maximum marks of SEE. A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 50% (50 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks**

Two assignments each of **20 Marks** or **one Skill Development Activity of 40 marks**

to attain the COs and POs

The sum of three tests, two assignments/skill Development Activities, will be **scaled down to 50 marks**

CIE methods /question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for thecourse.

Semester End Examination:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 50.The

question paper will have ten full questions carrying equal marks.

Each full question is for 20 marks. There will be two full questions (with a maximum of four sub-questions) from each module.

Each full question will have a sub-question covering all the topics under a module.

Suggested Learning Resources:

Books

1. Biotechnology- Expanding Horizons. B.D. Singh, Kalyani Publishers, 4th Edition, 2012
2. Crop Biotechnology. K. Rajashekaran, T.J. Jacks and J.W. Finley, American Chemical Society, 1st Edition, 2002 \
3. Textbook of Agricultural Biotechnology. Ahindra Nag, PHI learning publication, 1st Edition, 2008
4. Plant Tissue Culture: Theory and Practice. S.S. Bhojwani and M.K. Razdan, Elsevier Science, 1996
5. Plant biotechnology in Agriculture. K. Lindsey and M.G.K. Jones, Prentice Hall, 1990
6. Plant Biotechnology and Agriculture- Prospects for the 21st Century. Arie Altman and Paul Hasegawa, Academic Press, 1stEdition, 2011
7. Agricultural Biotechnology in Developing Countries: Towards Optimizing the Benefits for the Poor. Ed: Matin Qaim, Anatole F. Krattiger, Joachim von Braun, Springer, 1st Edition, 2000

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/watch?v=z6x1HZDQtKQ
2. https://www.youtube.com/watch?v=VsYax7b09GU
3. https://www.digimat.in/nptel/courses/video/102104069/L32.html
4. https://www.digimat.in/nptel/courses/video/102106080/L01.html
5. https://www.digimat.in/nptel/courses/video/102104088/L29.html

Skill Development Activities Suggested

1. Class Presentations and discussions of research articles from publications.
2. Online tools for surprise quizzes.
3. Collection of case studies via Newspapers/Journal articles, on topics covered.
4. Group discussions on recent advancements and case studies.

Course outcome (Course Skill Set)

At the end of the course the student will be able to :

Sl. No.	Description	Blooms Level
CO1	Understand conventional crop improvement programs and the role agricultural biotechnology in food security and national economy	L1, L2, L3
CO2	Apply biotechnological approaches for crop improvement	L1, L2, L3, L4
CO3	Apply plant tissue cultural methods for crop improvement	L1, L2, L3
CO4	Evaluate uses of antisense RNA technology and biotechnology in agriculture	L1, L2, L3, L4, L5
CO5	Evaluate legal and socioeconomic impacts of biotechnology	L3, L4, L5, L6

Program Outcome of this course

Sl. No.	Description	POs
1	An ability to independently carry out research /investigation and development work to solve practical problems	PO1
2	An ability to write and present a substantial technical report/document	PO2

3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program	PO3
4	Students should be able to acquire technical, research, managerial and entrepreneurialskills related to food technology so that they can analyze, evaluate and solve problems related to food and adapt to changing needs of industry and society	PO4
5	Students should be able to evaluate food quality and safety & apply food laws and regulations for acceptability of food products	PO5

Mapping of COS and POs

	PO1	PO2	PO3	PO4	PO5
CO1			3		
CO2			3		
CO3			3	3	
CO4			3	3	
CO5			3		