VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI.

Scheme of Teaching and Examinations and Syllabus

M. Tech FOOD BIOTECHNOLOGY (FDB)

(Effective from Academic year 2020 - 21)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examinations – 2020- 21
M. Tech in FOOD BIOTECHNOLOGY (FDB)
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

I SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20FDB11	Numerical methods & Biostatistics	03	--	02	03	40	60	100	4
2	PCC	20FDB12	Food Microbiology	03	--	02	03	40	60	100	4
3	PCC	20FDB13	Food Chemistry	03	--	02	03	40	60	100	4
4	PCC	20FDB14	Principles of Food Analysis and Food law	03	--	02	03	40	60	100	4
5	PCC	20FDB15	Fundamentals of Food Engineering	03	--	02	03	40	60	100	4
6	PCC	20FDBL16	Food Analysis and Quality control Lab	--	04	--	03	40	60	100	2
7	PCC	20RMI17	Research Methodology and IPR	02	--	02	03	40	60	100	2
			TOTAL	**17**	**04**	**12**	**21**	**280**	**420**	**700**	**24**

Note: PCC: Professional core.

Skill development activities:

Students and course instructor/s to involve either individually or in groups to interact together to enhance the learning and application skills.

The students should interact with industry (small, medium and large), understand their problems or foresee what can be undertaken for study in the form of research/ testing / projects, and for creative and innovative methods to solve the identified problem.

The students shall

(1) Gain confidence in modelling of systems and algorithms.
(2) Work on different software/s (tools) to Simulate, analyse and authenticate the output to interpret and conclude. Operate the simulated system under changed parameter conditions to study the system with respect to thermal study, transient and steady state operations, etc.
(3) Handle advanced instruments to enhance technical talent.
(4) Involve in case studies and field visits/ field work.
(5) Accustom with the use of standards/codes etc., to narrow the gap between academia and industry.
(6) All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.

Internship: All the students have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted for the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the

internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.
Note: (i) Four credit courses are designed for 50 hours Teaching – Learning process. (ii) Three credit courses are designed for 40 hours Teaching – Learning process. (iii) Two credit courses are designed for 25 hours Teaching – Learning process.

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II SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Seminar	Skill Development Activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20FDB21	Functional Foods and Nutraceuticals	03	--	02	03	40	60	100	4
2	PCC	20 FDB22	Food Process Engineering	03	--	02	03	40	60	100	4
3	PCC	20 FDB23	Nutrigenomics And Bioentrepreneurship	03	--	02	03	40	60	100	4
4	PEC	20FDB24X	Professional elective 1	04	--	--	03	40	60	100	4
5	PEC	20 FDB25X	Professional elective 2	04	--	--	03	40	60	100	4
6	PCC	20 FDBL26	Food Biotechnology Lab	--	04	--	03	40	60	100	2
7	PCC	20 FDB27	Technical Seminar	--	02	--	--	100	--	100	2
TOTAL				**17**	**06**	**06**	**18**	**340**	**360**	**700**	**24**

Note: PCC: Professional core, PEC: Professional Elective.

Professional Elective 1		**Professional Elective 2**	
Course Code under 20 FDB	**Course title**	**Course Code under 20 FDB**	**Course title**
20 FDB 241	Grain Processing and	20 FDB 251	Dairy Technology
20 FDB 242	Genetics & Cell culture techniques	20 FDB 252	Fermentation Technology & Food Enzymes
20 FDB 243	Food Packaging and Storage Engineering	20 FDB 253	Food Product Development
20 FDB 244	Genomics, Proteomics & Bioinformatics	20 FDB 254	Food Industry Byproduct and Waste Management

Note:

1. Technical Seminar: CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Participation in the seminar by all postgraduate students of the programme shall be mandatory.

The CIE marks awarded for Technical Seminar, shall be based on the evaluation of Seminar Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

2. Internship: All the students shall have to undergo mandatory internship of 6 weeks during the vacation of I and II semesters and /or II and III semesters. A University examination shall be conducted during III semester and the prescribed internship credit shall be counted in the same semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared as fail in internship course and have to complete the same during the subsequent University examination after satisfying the internship requirements.

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III SEMESTER

Sl. No.	Course	Course Code	Course Title	Teaching Hours /Week			Examination				Credits
				Theory	Practical/ Mini-Project/ Internship	Skill Development activities	Duration in hours	CIE Marks	SEE Marks	Total Marks	
				L	P	SDA					
1	PCC	20FDB31	Secondary processing in Food technology	03	--	02	03	40	60	100	4
2	PEC	20 FDB 32X	Professional elective 3	03	--	--	03	40	60	100	3
3	PEC	20 FDB 33X	Professional elective 4	03	--	--	03	40	60	100	3
4	Project	20 FDB 34	Project Work phase -1	--	02	--	--	100	--	100	2
5	PCC	20 FDB 35	Mini-Project	--	02	--	--	100	--	100	2
6	Internship	20 FDB I36	Internship/ Professional Practice	(Completed during the intervening vacation of I and II semesters and /or II and III semesters.)			03	40	60	100	6
			TOTAL	**09**	**04**	**02**	**12**	**360**	**240**	**600**	**20**

Note: PCC: Professional core, PEC: Professional Elective.

Professional elective 3		**Professional elective 4**	
Course Code under 20FDB32X	**Course title**	**Course Code under 20FDB33X**	**Course title**
20 FDB321	Food Safety and Toxicology	20 FDB 331	Food Business Management and Entrepreneurship Development

20 FDB 322	Food Allergies and Allergens	20 FDB 332	Meat & Marine food products
20 FDB 323	Food Additives and Preservatives	20 FDB 333	Nanotechnology in food industry
20 FDB 324	Food production system and Post harvest technology	20 FDB 334	Automation & Robotics in food processing

Note:

1. Project Work Phase-1: Students in consultation with the guide/co-guide if any, shall pursue literature survey and complete the preliminary requirements of selected Project work. Each student shall prepare relevant introductory project document, and present a seminar.

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide if any, and a senior faculty of the department. The CIE marks awarded for project work phase -1 shall be based on the evaluation of Project Report, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE (University examination) shall be as per the University norms.

2. Internship: Those, who have not pursued /completed the internship shall be declared as fail in internship course and have to complete the same during subsequent University examinations after satisfying the internship requirements. Internship SEE (University examination) shall be as per the University norms.

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IV SEMESTER

Sl. No	Course	Course Code	Course Title	Teaching Hours /Week		Examination				Credits
				Theory	Practical/ Field work	Duration in hours	CIE Marks	SEE Marks Viva voce	Total Marks	
				L	P					
1	Project	20FDB41	Project work phase -2	--	04	03	40	60	100	20
			TOTAL	--	**04**	**03**	**40**	**60**	**100**	**20**

Note:

1. Project Work Phase-2:

CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a Senior faculty of the department. The CIE marks awarded for project work phase -2, shall be based on the evaluation of Project Report subjected to plagiarism check, Project Presentation skill and performance in Question and Answer session in the ratio 50:25:25.

SEE shall be at the end of IV semester. Project work evaluation and Viva-Voce examination (SEE), after satisfying the plagiarism check, shall be as per the University norms.

NUMERICAL METHODS & BIOSTATISTICS

Course Code	20FDB11	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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

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.

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

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.

Module-5

Statistics In Microarray, Genome Mapping And Bioinformatics:

Types of microarray, objectives of the study, experimental designs for micro array studies, microarray analysis, interpretation, validation and microarray informatics. Genome mapping, discrete sequence matching

Course outcomes:

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

1. Demonstrate strong basics in statistics and numerical analysis,
2. foundation to tackle live problems in various spheres of bioscience and bioengineering
3. Study and design various statistical problems

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

(1) Alvin E. Lewis, Biostatistics, McGraw-Hill Professional Publishing, 2013

(2) J.D. Lee and T.D. Lee. Statistics and Numerical Methods in BASIC for Biologists, Van Nostrand Reinhold Company, 1982.

Reference Books

1. Wolfgang Boehm and Hartmut Prautzsch, Numerical Methods, CRC Press, 1993.
2. John F. Monahan. Numerical Methods of Statistics (Cambridge Series in Statistical and Probabilistic Mathematics), Cambridge University Press, 2011.
3. Joe D. Hoffman. Numerical Methods for Engineers and Scientists, CRC Pres 2nd Edition, 2001.
4. Warren J. Ewens Gregory Grant, Statistical Methods in Bioinformatics: An Introduction
5. Wolfgang Boehm and Hartmut Prautzsch, Numerical Methods, CRC Press, 1993.

FOOD MICROBIOLOGY

Course Code	20FDB12	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

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.

Module-2

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.

Module-3

Food fermentations:

Different types of fermentations (solid -state, submerged, static, agitated, batch, continuous). Starter cultures, Probiotic cultures, Fermented foods - types, methods of manufacture for vinegar, ethyl alcohol, cheese, yoghurt, baker's yeast and traditional Indian foods.

Module-4

Microbial food borne diseases and detection of microbes

Types of microbial food borne diseases (food borne intoxications and Food borne infections), 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.

Module-5

Food preservation by controlling microbes Principles of preservation, methods of food preservation – high temperature, low temperature, drying, radiation, , antimicrobial agents (types- chemical preservatives, bio-preservatives, mode of action and their application), hurdle technology, active packaging, novel processing technologies.

Course outcomes:

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

1. Understand the factors that influence the microbial growth in foods.
2. Apply their knowledge to control microbes in foods and use microbes for beneficial effects in foods.
3. Learn evaluation of food samples by different methods for microbial contamination.
4. Learn to analyze food borne pathogens and their toxins.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Food Microbiology. W C Frazier & D C West off
2. Modern Food Microbiology
3. Essentials of Food Microbiology. John Garbutt
4. The Microbiology of Safe Food
5. Fundamentals of Food Microbiology. Bibek Ray and Arun Bhunia

6. Microbiology of foods. J. C. Ayres

Reference Books

1. Microbiology. M.J. Pelczar Jr
2. General Microbiology. H.G. Schleigel
3. Microbiology. Prescott
4. General Microbiology. C.B. Powar and H.F. Daginawala
5. Practical Microbiology. R.C. Dubey and D.K. Maheswari

FOOD CHEMISTRY

Course Code	20FDB13	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Proteins: Nomenclature, classification, structure, chemistry and properties of amino acids, peptides, proteins; Essential and non-essential amino acids, Qualitative and quantitative analysis of amino acids and proteins, Changes during food processing. Browning reactions: Enzymatic and non enzymatic browning, advantages and disadvantages, factors affecting their reaction and control.

Module-2

Carbohydrates: Nomenclature and classification, structure, physical and chemical properties of polysaccharides and their functions; Qualitative and quantitative analysis of carbohydrates; changes in carbohydrates during food processing.

Module-3

Lipids: Structure, classification, physical and chemical properties, utilization of fats and oils, margarine, shortenings, salad and cooking oils, importance of fats and oils in diet, introduction to hydrogenation and its importance.

Module-4

Introduction to human nutrition and Dietary requirements of nutrients: 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.

Module-5

Food ingredients and additives: classification and functions, need for food ingredients and additives, Permitted dosages of food additives , food preservatives, antimicrobial agents, thickeners-polysaccharides, bulking agents;

Antifoaming agents, synergists, antagonists. Antioxidants (synthetic and natural, mechanism of oxidation inhibition), chelating agents- types, uses and mode of action; Coloring agents-color retention agents, applications and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), Sweeteners- natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of various sweeteners in food products; Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

Course outcomes:

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

1. Understand different chemical components of food.
2. Apply food chemistry knowledge for improving shelf life and attributes of foods.
3. Apply knowledge of role of nutrition and healthy eating for disease prevention and wellness;
4. Learn to evaluate the levels of food additives.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Principles of Biochemistry
2. Textbook of Biochemistry. E. S. West
3. Nutrition and Dietetics. Shubhangini A. Joshi
4. General Biochemistry. J.H. Weil
5. Biochemistry of Foods. N.A.M Eskin
6. Food Chemistry. O.R. Fennema

Reference Books

1. Essentials of Food and Nutrition. M. S. Swaminathan
2. Outlines of Biochemistry. Eric E. Conn and P.K. Stumpf
3. Fundamentals of Biochemistry. J L Jain
4. Biochemistry. U Satyanarayana and U. Chakrapani
5. Textbook of Nutrition and Dietetics. Kumud Khanna

PRINCIPLES OF FOOD ANALYSIS AND FOOD LAWS

Course Code	20FDB14	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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).

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.

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).

Course outcomes:

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

- Identify and determine error sandun certainty of analytical results;
- Apply measures taken to control quality and ensure reliability of analytical results.
- Apply the knowledge for production of fermented foods
- Learn evaluation of food analysis by different analytical methods.

  Apply the knowledge of International Food Policies in Food sector development.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

1. The question paper will have 10 full questions carrying equal marks.
2. Each full question is for 20marks.
3. There will be 2 full questions (with maximum of 4 sub questions) from each module.
4. Each full question will have sub question/s covering all the topics under a module.
5. The student will have to answer 5 full questions, selecting 1 full question from each module.

Textbook/ Textbooks:

1. Food Microbiology. W C Frazier & D C Westhoff
2. Modern Food Microbiology
3. Essentials of Food Microbiology. John Garbutt
4. The Microbiology of Safe Food
5. Fundamentals of Food Microbiology. Bibek Ray and Arun Bhunia
6. Microbiology of foods. J. C. Ayres

Reference Books:

1. Microbiology. M.J. Pelczar Jr
2. General Microbiology. H.G. Schleigel

3. Microbiology. Prescott
4. General Microbiology. C.B. Powar and H.F. Daginawala
5. Practical Microbiology. R.C. Dubey and D.K. Maheswari

FUNDAMENTALS OF FOOD ENGINEERING

Course Code	20FDB15	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction to food engineering: Material and energy balances- Basic principles, total mass and component mass balance. Material balance calculations involved in dilution, concentration and dehydration. Heat balance calculations. Fluid flow theory and application - Fluid statics and fluid dynamics, mass and energy balances in fluid flow. Newtonian and non-Newtonian fluids, streamline and turbulent flow. Fluid flow applications- measurement of pressure and velocity. Liquid transport system. Pipelines and pumps for food processing plants-positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps.

Module-2

Heat transfer in food processing: Thermal properties of foods, modes of heat transfer, conductive heat transfer in a rectangular slab, tubular pipe, and multilayered systems. Natural and forced convection. Estimation of convective heat transfer coefficient in forced and natural convection. Estimation of overall heat transfer coefficient.

Module-3

Heat exchangers: Plate, tubular, scraped surface, and steam infusion. Thermal process calculation- Commercial sterility concept, Microbial inactivation rates at constant temperature. Effect of temperature on thermal inactivation of microorganisms. Calculation of processing time in continuous flow systems.

Module-4

Psychrometrics: Properties of dry air, composition of air, specific volume of air, specific heat of dry air, enthalpy of dry air, dry bulb temperature. Properties of water-vapor- Specific volume, specific heat and enthalpy. Properties of air-vapor mixtures- Gibbs-Dalton law, Dew-point temp, humidity ratio, relative humidity, wet bulb temperature. The psychrometric chart- Use of psychrometric chart to evaluate complex air conditioning processes.

Module-5

Material handling: Theory and classification of various material handling equipments. Conveyors (gravity and powered conveyors), elevators (bucket and screw-type elevators), trucks (high lift and pallet trucks), cranes and hoists. Sorting and grading– advantages and methods.

Course outcomes:

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

1. Understand Basics of Fundamentals of Food Processing Operations.
2. Apply working of equipments in Food Industry related to transport of Fluids, Thermal Processing and Material Handling along with basics as applied to Food Processing Operations.
3. Analyze basics of Psychometrics & Air Conditioning Processes related to Food Processing Operations.
4. Understand basics of Mathematical Calculations related to above Engineering Applications as applied to Food Processing Operations.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

1. The question paper will have 10 full questions carrying equal marks.
2. Each full question is for 20marks.
3. There will be 2 full questions (with maximum of 4 sub questions) from each module.
4. Each full question will have sub question/s covering all the topics under a module.
5. The student will have to answer 5 full questions, selecting 1 full question from each module.

Textbook/ Textbooks:

1. Singh, R. P., & Heldman, D. R (2014). Introduction to Food Engineering (5th ed.): Academic Press, New Delhi.
2. Saravacos, G. D., & Maroulis, Z. B. (2011).
3. Food Process Engineering Operations: CRC Press, Boca raton. Toledo, R.T. (2007).
4. Fundamentals of Food Process Engineering (3rd ed.): Springer, New York. Gustavo, V. B-C., & Ibarz, A. (2002).
5. Unit Operations in Food Engineering: CRC Press. Lozano, J. E (2000).
6. Trends in Food Engineering. Rao, D.G (2014).

7. Fundamentals of Food Engineering: PHI Learning, Delhi Heldman, R & Daryl, B (2007).
8. Handbook of Food Engineering (2nd ed.): CRC Press

Reference Books:

1. Smith
2. Stavros Yanniotis (2008). Solving Problems In Food Engineering; Springer

FOOD ANALYSIS AND QUALITY CONTROL LAB

Course Code	20FDBL16	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

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 and sugar concentration in food samples
3	Qualitative analysis of oils and fats
4	Determination of microbial counts in milk samples
5	Analysis of milk for quality
6	Analysis of milk for detection of adulterants
7	Determination of BAR (Brix Acid Ratio) in beverages
8	Evaluation of food labels of products for PFA standards
9	Identification of food additives by using FTIR or GC or HPLC
10	Verification of packaging material by FTIR method

Course outcomes:

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

1. Analyze different food samples for quality.
2. Evaluate food samples for quality.
3. Evaluate food samples for chemical and microbial safety.
4. Analyze the data for the acceptability of food samples.

Question paper pattern:

The SEE question paper shall be for 100 marks. The marks scored by the candidate will be proportionately reduced to 60.

Textbooks:

1. Pearson's Composition and Analysis of Foods. Ronald S. Kirk and Ronald Sawyer
2. Quality Control for Food Industry. A Krammer
3. Food Quality Control. Manoranjan Kalia

Reference Book:

Handbook of Analysis and Quality Control of fruits & Vegetables Products. S Ranganna, Tata Mc Grow Hill Publications, 2nd Edition, 1986

RESEARCH METHODOLOGY AND IPR

Course Code	20RMI17	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	2:0:2	SEE Marks	60
Credits	02	Exam Hours	03

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.

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, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.

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.

Data Collection: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method.

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.

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.

Course outcomes:

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

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

Question paper pattern:

- The question paper will have ten questions.
- Each full question is for 20 marks.
- There will be 2full questions (with a maximum of four sub questions in one full question) from each module.
- Each full question with sub questions will cover the contents under a module.
- Students will have to answer 5 full questions, selecting one full question from each module.

Textbooks

(1) Research Methodology: Methods and Techniques, C.R. Kothari, Gaurav Garg,New Age International,4th Edition, 2018.

(2) Research Methodology a step-by-step guide for beginners. (For the topic Reviewing the literature under module 2), RanjitKumar,SAGE Publications,3rd Edition, 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, September 2013.

Reference Books

(1) Research Methods: the concise knowledge base, Trochim, Atomic Dog Publishing, 2005.

(2) Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009.

FUNCTIONAL FOODS AND NUTRACEUTICALS

Course Code	20FDB21	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

Module-3

Nutraceuticals of plant and animal origin: Plant secondary metabolites, Animal metabolites, Fat rich functional food and their applications - Functional Fats and Spreads, modified fats and oils. Functional Confectionery and other functional Products**.**

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).

Module-5

Nutrition, Classification, Benefits and Uses, Herbal Food Supplements, Preventive Care , Health care products as daily supplements.

Nutritional supplements, Preventive care in Health Management by AYUSH, Importance and Necessity, Balanced nutrition and diet.

Course Outcomes:

1. Have a clear vision about various food ingredients and their functional properties.
2. Apply his understanding to select appropriate food for particular disease control.
3. Learn how to evaluate functional foods with respect to different regulations.
4. Analyze the functional claims with respect to packaging and labeling.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Functional Foods: Principles and Technology. M. Guo
2. Functional Foods Concept to Product. Glenn R. Gibson and Christine M. Williams
3. Functional Foods and Nutraceuticals. R.E. Aluko

Reference Books

1. Functional Dairy Products. T Mattila-Sandholm and M. Saarela
2. Handbook of Nutraceuticals and Functional Foods. Robert E. C. Wildman
3. Handbook of Fermented Functional Foods. Edward R.(Ted) Farnworth
4. Essentials of Functional Foods. Mary K. Schmidl and Theodore P. Labuza

FOOD PROCESS ENGINEERING

Course Code	20FDB22	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Properties of Foods & Food Processing at ambient temperature

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.

Module-2

Food Processing at ambient temperature Mixing and Forming- Mixing: Theories of solids and liquids mixing, equipment, effect of 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.

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.

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.

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.

Course outcomes:

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

1. Learn different food engineering processes.
2. Understand principles of different food engineering processes.
3. Evaluate merits and demerits of different food engineering processes.
4. Apply his understanding to select appropriate process for food processing operations.

Question paper pattern:
The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Fundamentals of food engineering. D.G. Rao
2. Food processing technology - principles and practice. P.J. Fellows
3. Handbook of Food Engineering Practice**.** Kenneth J. Valentas
4. Introduction to Food Process Engineering
5. Unit Operations in Food Processing. R.L. Earle and M.D. Earle

Reference Books

1. Food Process Operations. H. Das
2. Unit Operations of Agricultural Processing. K.M. Sahay and K.K. Singh
3. Food Engineering and Dairy Technology. H.G. Kessler
4. Physical Properties of Food and Food Processing System
5. Introduction to Food Engineering. R Paul Singh & Dennis R Heldman
6. Transport Phenomena in Food Process Engineering

NUTRIGENOMICS AND BIOENTREPRENEURSHIP

Course Code	20FDB23	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Genetic interactions: Gene- environment interaction; gene- diet interaction; principals and practice behind dietary management of genetically transmitted disorders.

Genetic disorders: Phenylketonuria, galactosemia; G6PD deficiency; lactose intolerance; complex traits; birth disorders; signal transduction; epigenetic mechanism.

Importance of nutrigenomics Bioactive components of food; nutraceuticals; effective gene expression; epigenetic process; signal transduction; recent developments in field of nutrigenomics

Module-2

Innovation and entrepreneurship in bio-business

Introduction and scope in Bio-entrepreneurship, Types of bio-industries and competitive dynamics between the sub-industries of the bio-sector (e.g. pharmaceuticals vs. Industrial biotech), Strategy and operations of bio-sector firms: Factors shaping opportunities

for innovation and entrepreneurship in bio-sectors, and the business implications of those opportunities, Alternatives faced by emerging bio-firms and the relevant tools for strategic decision, Entrepreneurship development programs of public and private agencies (MSME, DBT, BIRAC, Make In India), strategic dimensions of patenting & commercialization strategies.

Module-3

Bio markets: business strategy and marketing: Negotiating the road from lab to the market (strategies and processes of negotiation with financers, government and regulatory authorities), Pricing strategy, Challenges in marketing in bio business (market conditions & segments; developing distribution channels, the nature, analysis and management of customer needs), Basic contract principles, different types of agreement and contract terms typically found in joint venture and development agreements, Dispute resolution skills.

Module-4

Finance and accounting

Business plan preparation including statutory and legal requirements, Business feasibility study, financial management issues of procurement of capital and management of costs, Collaborations & partnership, Information technology.

Module-5

Technology management: Technology – assessment, development & up gradation, Managing technology transfer, Quality control & transfer of foreign technologies, Knowledge centers and Technology transfer agencies, Understanding of regulatory compliances and procedures (CDSCO, NBA, GCP, GLA,GMP).

Course outcomes:

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

1. Understand the factors that influence the gene interactions and importance of nutrigenomics.
2. Apply his knowledge to Innovation and entrepreneurship in bio-business.
3. Learn evaluation of business strategy and marketing.
4. Learn to analyze finance and accounting and technology management.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. T. R. Banga & s. C. Sharma
2. C.B.Mamoria and S.V.Gankar
3. Veerabhadra Havinal
4. Ramesh Burbure – Management &Entrepreneurship

Reference Books

1. Poornima M. Charanthimath – Entrepreneurship Development, Pearson Education-2005 7 Stein Hoff - "Small Business Management Fundamentals", Mc Graw Hill, 1980.
2. Milton, Bum & James - "Industrial Psychology", 6th.Edn, Harper International, 1968.

FOOD BIOTECHNOLOGY LAB

Course Code	20FDBL26	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	0:4:0	SEE Marks	60
Credits	02	Exam Hours	03

Experiments

Sl. NO	
1	Discontinuous native PAGE
2	SDS PAGE
3	Ammonium sulphate precipitation of enzyme
4	Purification of enzyme by three phase partitioning
5	TLC separation
6	Demo of Gel Filtration Chromatography/ IEC
7	Isolation of genomic DNA
8	DNA amplification by PCR
9	Restriction digestion
10	Agarose gel electrophoresis
11	Immunodiffusion
12	Enzyme assay using ELISA reader
13	Fruit processing using enzymes.

Course outcomes:

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

1. Learn different of protein separation methods.
2. Evaluate the performance of different purification of proteins.
3. Determine separate DNA and digest the DNA
4. Analyze the food processing techniques.

Question paper pattern:

The SEE question paper shall be for 100 marks. The marks scored by the candidate will be proportionately reduced to 60.

Textbooks:

1. Principles of Gene manipulation
2. Current protocols in molecular biology
3. Genetic Engineering Vol.1

Reference Book:

Molecular cloning Volumes I, II, III-Sambrook J *et al* (2000).Cold Spring Harbor Lab, 2000.

GRAIN PROCESSING AND BAKING TECHNOLOGY

Course Code	20FDB241	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Grain processing and milling: Production, Economics, and processing scenario of Food grains. Classification, structure and physicochemical properties and thermal properties of Food grains; Unit operations and equipment for Food Grain Processing, Processing and storage of cereals, pulses and oil seeds. Commercial processing of Paddy, wheat, Corns, Barley, Millets, Pulses and Oil seeds. Dry Milling (Rice and Wheat), Wet Milling (Maize) and parboiling of rice.

Module-2

Baking Technology: Introduction of bakery products-bread, biscuit, cake, pastries, rusk, crackers. PFA specifications of bakery products. Bread types; role of major and minor ingredients; processes of bread making; problems associated with bread making; equipment for bread manufacturing; processing steps for biscuit, cookies, cracker, cakes and their major and minor ingredients. Nutritional aspect of bakery products; quality evaluation of baked products.

Module-3

Confectionary: Historical development; classification of confectionary products; basic technical considerations for confectionary products- TS, TSS, pH, acidity, ERH, RH etc. raw materials and their role in confectionary products; traditional confectionary products.

Module-4

Chocolate & Vanilla processing: Historical development in chocolate processing; ingredients and their role in chocolate; Steps of chocolate processing- mixing, refining, conching, tempering, molding, cooling, coating, enrobing, etc. Vanilla- Production, processing and packaging.

Module-5

Candies and Toffee: High boiled sweets/candy-composition, production and preparation of high boiled sweets- traditional, batch and continuous methods; toffee composition, types, ingredient and their role, batch and continuous methods of toffee manufacturing.

Rural Marketing of FMCG's: Indian FMCG industry, characteristics of Indian FMCG sector, Challenges in the FMCG industry, Rural Marketing of FMCG's: Select case studies

Course outcomes:

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

1. Understand various processes and methods of grain processing.
2. Evaluate the quality of bakery products.
3. Apply baking knowledge for developing new products.
4. Analyse and compare the processing methods of different grains.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Bakery Science & Cereal Technology. Neelam Khetarpaul, Daya Books, 1st Edition, 2005.
2. Kent's Technology of Cereals: An Introduction for Students of Food Science and Agriculture.
3. N.L. Kent, Woodhead Publishing Imprint, 4th Edition, 1994
4. Post-Harvest Technology of Cereals, Pulses and Oil Seeds. A. Chakravarty, Oxford & IBH Publishing
5. Bakery Products Science and Technology. Weibiao Zhou and Y. H. Hui, Wiley Blackwell, 2nd Edition,
6. The Complete Technology Book on Bakery Products. NIIR Board of Consultants & Engineers, NPCS,

Reference Books

1. Biscuit
2. Baking Problems Solved. S.P. Cauvain and L.S. Young
3. Flat Bread Technology. J. Qarooni
4. Unit Operations in Agricultural Processing. K.M. Sahay and K.K.Singh
5. Bakery Science and Food Technology. Neetam Khetarpaul

GENETICS AND CELL CULTURE TECHNIQUES

Course Code	20FDB242	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Overview of genetics: Chemical structure of nucleic acids, proteins; introduction to Genetics, DNA replication, transcription and translation; DNA repair mechanism; modifying enzymes; Genetic code, Regulation of gene expression in Prokaryotes and Eukaryotes.

Module-2

Genetic engineering: Recombinant DNA technology- Methodology Involved PCR, RT-PCR, electrophoresis, electro blotting and capillary blotting; microbial gene transfer mechanisms, mutation, types of mutations, molecular mechanism of mutations, applications to produce genetically modified foods.

Module-3

Cell culture technology: Introduction to plant and animal tissue cultures and cell cultures in general; Cell culture lab design and equipments, Media and reagents; Animal, mammalian and other cell lines for in vitro testing of drugs, toxicity of environmental pollutants, production of vaccines and therapeutic proteins & production of stem cells; Principles of cryobiology and molecular diagnostics, Technological aspects for commercial utilization of cell cultures: Reactor studies, scale up and biosafety.

Module-4

Cell Lines: Primary culture – Mechanical and enzymatic mode of desegregation, establishment of primary culture. Subculture -passage number, split ratio, seeding efficiency, criteria for subculture. Cell lines -definite and continuous cell lines, characterization, authentication, maintenance and preservation of cell lines. Contamination -bacterial, viral, fungal and mycoplasma contaminations, detection and control, cell transformation – normal vs. transformed cells.

Module-5

Cell Culture: Scale-up of animal cell culture – Factors to be considered. Scale-up of suspension cultures Batch reactor, continuous culture, perfusion systems. Scale-up of monolayer cultures – roller bottles, Nunc cell factory, microcarrier cultures, organotypic culture, matrices, factors affecting culture and perspectives.

Course outcomes:

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

1. Understand the concepts of gene expression and gene regulation.
2. Apply his knowledge to produce GMO
3. Learn evaluation of cell line growth characteristics.
4. Learn to analyze scale up techniques.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Culture of Animal Cells, (3rd Edn) R Ian Fredhney. Wiley-Liss Animal Cell Biotechnology, 1990-Spier, RE and Griffith, JB Academic Press, London

2. Animal Biotechnology by Murray Moo-Young (1989), Pergamon Press, Oxford Animal Cell Technology, Principles and practices, 1987, Butter, M Oxford press
3. Molecular Biotechnology by Primrose.
4. Plant Cell Culture: A Practical Approach by R.A. Dixon & Gonzales, IRL Press.
5. Plant biotechnology in Agriculture by K. Lindsey and M.G.K. Jones (1990), Prentice hall, New Jersey
6. Principles of gene manipulation - An introduction to genetic engineering, Old R.W.,
7. Primrose S.B., Blackwell Scientific Publications, 1993.

Reference Books

1. Recombinant DNA by Watson et al.
2. Principles of Biochemistry by Lehninger AL.

FOOD PACKAGING AND STORAGE ENGINEERING

Course Code	20FDB243	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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.

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.

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.

Course outcomes:

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

1. Learn about packaging materials, packaging systems and food storage.
2. Apply his understanding to select appropriate packaging.
3. Learn to evaluate suitability of appropriate storage system.
4. Evaluate bio- films for various food packaging.
5. Learn how to test materials for their suitability for packaging.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

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

GENOMICS, PROTEOMICS & BIOINFORMATICS

Course Code	20FDB244	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

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.

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).

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).

Module-5

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.

Course outcomes:

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

1. Develop an understanding of basic theory of these computational tools.
2. Gain working knowledge of these computational tools and methods.
3. Appreciate their relevance for investigating specific contemporary biological questions.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook

1. A.D. Baxevanis and B.F.F. Ouellette (Eds). (2002)
2. D.W. Mount

Reference Books

1. Jones & Peuzner, (2004); Introduction to Bioinformatics Algorithms; Ane Books, India.
2. Web-resources and suggested reviews/ research papers.

DAIRY TECHNOLOGY

Course Code	20FDB251	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

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.

Module-2

Unit Operations in Milk Processing: Principles of milk processing: Filtration, milk storage, bulk cooling, stirring and mixing, standardization, pasteurization, sterilization, centrifugation, homogenization, evaporation and condensation.

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.

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.

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.

Course outcomes:

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

1. Have clear vision about milk processing and preservation.
2. Understand the principles of processing of milk and milk products.
3. Gain technical insights about advanced methods of milk processing.
4. Evaluate different methods for the selection of appropriate method for milk processing.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook:

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

Reference Books

1. Cheese and Butter by V. Cheke and A. Sheeprd
2. Dairy Chemistry and Biochemistry. P. F. Fox
3. Dairy Technology: Principles of Milk Properties and Processes. P. Walstra.

FERMENTATION TECHNOLOGY AND FOOD ENZYMES

Course Code	20FDB252	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Introduction & Enzyme kinetics: Nature, Function, classification & nomenclature of enzymes, Specificity, Michaeli's Menton equation, $K_{m,}$ Lineweaver Berk Plot, Different inhibitors.

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.

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.

Module-4

Fermentation Technology: Sterilization methods of Fermentors; Scale up and scale down; Biomass Production; Enzyme Production; Downstream processing.

Module-5

Fermentors: Fermentor design and analysis; Aeration and Heat Transfer; Instrumentation and Control; Batch, Fed batch and continuous bioreactors.

Course outcomes:

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

1. Know different enzymes used during food processing.
2. Learn applications of enzymes during food processing
3. Understand about the production and purification of enzymes.
4. Evaluate different fermentation technologies for the economic production of enzymes.
5. Analyze different fermentor designs.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook:

1. Principles of Biochemistry. Lehninger
2. Biochemical Engineering Fundamentals. J.E. Baily and D.F. Ollis
3. Biochemistry. D. Voet and J.G. Voet
4. Industrial Microbiology. Samuel C Prescott and Cecil G Dunn
5. Principles of Fermentation Technology. P.F. Stanbury and A. Whitaker

Reference Books

1. Microbiology: Principles and Explorations
2. Outlines of Biochemistry. Eric E Conn
3. Handbook of Fermented Functional Foods. Edward R.(Ted) Farnworth
4. Enzyme Technology. S. Shanmugam
5. Enzymes in Food Processing: Fundamentals and Potential Applications. Parmjit S. Panesar

FOOD PRODUCT DEVELOPMENT

Course Code	20FDB253	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

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

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.

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 ilot scale.

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.

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.

Course outcomes:

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

1. Understand the process of new product development.
2. Analyze the market for new product.
3. Analyze availability and cost competitiveness for new products.
4. Evaluate economics and commercialization of new product.
5. Evaluate process control parameters during scale-up of product.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook:

1. Food Product Development: Maximizing Success. R. Earle and A. Anderson
2. New Food Product Development: From Concept to Marketplace

Reference books:

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

FOOD INDUSTRY BYPRODUCTS & WASTE MANAGEMENT

Course Code	20FDB254	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	4:0:0	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Byproducts I

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

Module-2

Byproducts II

By products of meat and fish processing units and their uses. Uses of byproducts of agro based industries in various sectors.

Module-3

Various laws and regulations for waste management in food processing industries.

Module-4

Food industry wastes, Waste treatment methods for Cereals, Fruits, vegetables, Meat, Fish, Dairy processing and Brewery Industries.

Module-5

Waste water treatment-Preliminary treatment, primary, secondary, advanced and final treatment; zero-discharge and zero-emission system.

Course outcomes:

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

1. Apply his understanding for the management of different food industry wastes.
2. Understand laws and regulations for waste management in food industries.
3. Evaluate different waste treatment methods for selecting appropriate one.
4. Analyze and evaluate different waste water treatment methods for zero-discharge.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Handbook of Waste Management and Co-Product Recovery in Food Processing. K. Waldron
2. Waste Management for the Food Industries. I.S. Arvanitoyannis

Reference Books

1. Utilization of By-Products and Treatment of Waste in the Food Industry. Vasso Oreopoulou and Winfried Russ
2. Food Science. Norman N. Potter and Joseph H. Hotchkiss
3. Food Processing By-Products and their Utilization
4. Waste Management for the Food Industries. Ed. Ioannis S. Arvanitoyannis
5. Handbook of waste management and co-product recovery in food processing. Ed. Keith Waldron

TECHNICAL SEMINAR

Course Code	20FDB27	CIE Marks	100
Number of contact Hours/week (L:P:SDA)	0:0:2	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Each student, under the guidance of a Faculty, is required to

- Choose, preferably through peer reviewed journals, a recent topic of his/her interest relevant to the Course of Specialization.
- Carryout literature survey, organize the Course topics in a systematic order.
- Prepare the report with own sentences.
- Type the matter to acquaint with the use of Micro-soft equation and drawing tools or any such facilities.
- Present the seminar topic orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

The CIE marks for the seminar shall be awarded (based on the relevance of the topic, presentation skill, participation in the question and answer session and quality of report) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculties from the department with the senior most acting as the Chairperson.

Marks distribution for CIE of the course 20FDB27 seminar:

Seminar Report: 30 marks

Presentation skill:50 marks

Question and Answer:20 marks

*** END OF II SEMESTER***

SECONDARY PROCESSING IN FOOD BIOTECHNOLOGY

Course Code	20FDB31	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:2	SEE Marks	60
Credits	04	Exam Hours	03

Module-1

Overview of fermentation: fermentation as an ancient art, modern era of fermentation technology. Biology of industrial micro-organisms- isolation, screening and genetic improvement of industrially important micro-organisms.

Module-2

Fermentation systems: batch and continuous systems, fed-batch culture, feedback systems, fermenter design, solid substrate fermentation, Instrumentation and control. Fermentation raw materials- criteria used in media formulation influence of medium, raw materials for process control.

Module-3

Downstream processing: objectives, steps, problems, separation processes. Microbial production of various primary and secondary metabolites- alcohol, amino-acids, organic acids (citric acid and acetic acid), enzymes, antibiotics (penicillin, cephalosphorin). Principles of overproduction of metabolites.

Module-4

Biomass production: microbial production of single cell protein, Baker's yeast. Immobilized enzyme technology- methods of immobilization and applications.

Module-5

Membrane technology- methods and applications in bio processing. Waste treatment- introduction, waste treatment systems, microbial inoculants and enzymes for waste treatments.

Course outcomes:

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

1. Appreciate the positive role and benefits of microorganisms and enzymes in food production, processing, and preservation.
2. Understand basic biological and chemical processes of living cells, enzymes, and microbial nutrition in relation to fermentation processes.
3. Understand principles of inoculum /starter culture development for industrial fermentations and fermenter /reactor design, control and operation.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Crueger, W. & Crueger, A. (2000). Biotechnology: A Textbook of Industrial Microbiology (2^{nd} ed.): Panima, New Delhi.
2. Rehm, H. J., Red, G. (1993). Biotechnology: A Multi Volume Comprehensive Treatise (2^{nd} ed.): VCH, New York.
3. Stansbury, P. F., Whitakar, A. and Hall, S. J. (1997). Principles of Fermentation Technology (2^{nd} ed.): Pergamen Press, Oxford.

Reference Books

1. Reed, G. (1987). Prescott & Dunn's Industrial Microbiology (4th ed.): CBS, New Delhi.
2. Mansi, E. M. T. E. L. & Bryce, C. F. A. (1999). Fermentation Microbiology and Biotechnology.

FOOD SAFETY AND TOXICOLOGY

Course Code	20FDB321	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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.

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

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.

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.

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.

Course outcomes:

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

1. Able to understand various food safety parameters and also different toxicity issues in food industry.
2. Able to understand the concept of food ingredients & additives.
3. Able to understand toxicants in foods.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook:

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

Reference Books:

1. Wallace Hayes, Claire L. Kruger, (2014), Hayes' Principles and Methods of Toxicology. CRC Press.
2. William Helferich, Karl Winter, (2001), Food Toxicology. CRC Press.
3. Cynthia A. Robert, (2009), The food Safety Information Handbook. Greenwood.

FOOD ALLERGIES AND ALLERGENS

Course Code	20 FDB322	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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.

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.

Module-3

Characteristics of food allergenictiy: Natural sources and chemistry of food allergens, handling of food allergies; Detection & Diagnostic techniques for allergy, limitations of food allergy diagnostic techniques; Characterization of allergens, food sensitivities (anaphylactic reactions, metabolic food disorders and idiosyncratic reactions).

Module-4

Management of food allergenicity: Principles of management of food allergens including detailed knowledge of avoidance measures; Application of Genetic modification to reduce allergenicity; Methods used in safety evaluation-risk assessments.

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.

Course outcomes:

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

1. Able to recognize role of genetic, dietary and environmental factors in pathogenesis of food allergies.
2. Able to understand food allergies and allergens.
3. Able to know the preventive measures for food allergies and Regulatory and labeling procedures.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

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 Woodhead publishing .

Reference Books

1. Scott H. Sicherer. (2013). Food Allergy: Practical Diagnosis and Management. 1st edition CRC Press.
2. Ebisawa M. Sagamihara, Ballmer-Weber B.K. Zurich, Vieths S. Langen and Wood.
3. R.A. Baltimore, Md. (2015). Food Allergy: Molecular Basis and Clinical Practice. Karger Publishing.

FOOD ADDITIVES AND PRESERVATIVES

Course Code	20FDB323	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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.

Module-2

Food preservatives: Preservatives, antioxidants- chemistry, mechanism of action, properties and food applications.

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.

Module-4

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

Module-5

Food ingredients: Ingredients- carbohydrate, protein, fat based and nutraceutical ingredients, their production, properties and food applications

Course outcomes:

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

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

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

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, Toxicological and Health Perspective. Marcel Dekker, New York.

Reference Books

1. Morton ID & Macleod AJ. (1990). Food Flavours. Part A, B, C. Elsevier.
2. Nakai S; Modler HW. (2000). Food Proteins: Processing Applications. Wiley VCH.
3. Stephen AM. (Ed.). (2006). Food Polysaccharides and their Applications. Marcel Dekker.
4. T. E. Furia, Handbook of Food Additives, CRC Press.

FOOD PRODUCTION SYSTEM AND POST HARVEST TECHNOLOGY

Course Code	20FDB324	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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

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

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

Module-4

Factors involved with spoilage: Biotic, abiotic factors; temperature, insects, microbes; fungi, bacteria etc. quality and safety factors,

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.

Course outcomes:

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

1. To identify the physiology changes and their reasons occurring after fruit and vegetable harvest and 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.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks:

1. Post harvest physiology and pathology of vegetables by Jerry A Bartz.
2. Post Harvest Technology of Horticulture crops

Reference Books:

1. R.H.H. Wills et.al. An introduction to the Post-harvest physiology and handling of fruits and vegetables
2. Kadar AA.1992. Post-harvest Technology of Horticultural Crops. 2nd Ed. University of California.
3. Lal G, Siddapa GS & Landon GL.1986. Preservation of Fruits and Vegetables. ICAR.
4. Pantastico B. 1975. Post Harvest Physiology, Handling and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publ.
5. Salunkhe DK, Bolia HR & Reddy NR. 1991. Storage, Processing and Nutritional Quality of Fruits and Vegetables. Vol. I. Fruits and Vegetables. CRC.
6. Thompson AK. 1995. Post Harvest Technology of Fruits and Vegetables. Blackwell Sci.
7. Verma LR. & Joshi VK. 2000. Post Harvest Technology of Fruits and Vegetables. Indus Publ.

FOOD BUSINESS MANAGEMENT AND ENTREPRENEURSHIP DEVELOPMENT

Course Code	20FDB331	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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

Module-2

Project formulation: market survey techniques, project identification, project selection, project proposal, work breakdown structure.

Module-3

Network scheduling: activity, networks, use of CPM, PERT in project scheduling. Resource planning, resource allocation, project scheduling with limited resources.

Module-4

Estimation of project costs, earned value analysis, project techno- economic viability, break-even analysis. Identification of business opportunity in food processing sector. Government policies for promotion of entrepreneurship in food processing.

Module-5

Launching and organizing an enterprise, enterprise selection, market assessment, feasibility study, SWOT analysis, resource mobilization. Financial institution in promoting entrepreneurship; Supply chain management.

Course outcomes:

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

1. Understand how to analyze food project cost and techno-economic viability.
2. Learn how to evaluate and manage food business.
3. Apply the knowledge in food market assessment.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

1. Food Regulation: Law
2. A Practical Guide to Food Laws and Regulations. Kiron Prabhakar

Reference Books

1. Food Safety and Standards Act and Regulations
2. A Practical Guide to Food Laws and Regulations. Kiron Prabhakar
3. International Food Law and Policy. Gabriela Steier and Kiran Patel
4. Food Science. Norman N. Potter and Joseph H. Hotchkiss
5. Food Safety Implementation: from Farm to Fork. Ed. Puja Dudeja

MEAT AND MARINE FOOD PRODUCTS

Course Code	20FDB332	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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

Module-2

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

Module-3

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

Module-4

Poultry industry in India; Microbiology 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.

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

Course outcomes:

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

1. Able to understand various poultry products and Poultry industry in India.
2. Able to implement various meat hygiene processes and packaging process involved in meat industry.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook:

1. Forrest JC. Principles of Meat Science. Freeman.
2. Govindan TK. Fish Processing Technology. Oxford & IBH.
3. Hui YH. Meat Science and Applications. Marcel Dekker.
4. Kerry J. et al. Meat Processing. Woodhead Publ. CRC Press.

Reference Books:

1. Levie A. Meat Hand Book. 4th Ed. AVI Publ.
2. Mead M. Poultry Meat Processing and Quality. Woodhead Publ.
3. Mead GC. Processing of Poultry. Elsevier.
4. Pearson AM & Gillett TA. Processed Meat. 3rd Ed. Chapman & Hall.
5. Stadelman WJ & Cotterill OJ. Egg Science and Technology. 4th Ed. CBS.

NANOTECHNOLOGY IN FOOD INDUSTRY

Course Code	20FDB333	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

Module-1

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

Module-2

Nano Ingredients and additives: Nano materials for food applications- metal oxides, functionalized nanomaterials, nano additives, relation to digestion

Module-3

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.

Module-4

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

Module-5

Risks associated

ENP, health risks- toxins, metabolism action etc. Risk governance- principle Regulations. General regulations, safety aspects in different regions, Regulation aspects of nano scale food ingredients, additives, FCMS.

Course outcomes:

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

1. Able to understand various Types of Nano materials
2. Able to understand and apply nanotechnology in Agriculture

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook/ Textbooks

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 Francis Group, 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).

Reference Books

1. Q. Huang -Nanotechnology in the Food, Beverage and Nutraceutical Industries. Woodhead Publishing
2. Limited - 2010
3. Lestie prey, “Nanotech in food products”, Wiley publications 2010.
4. Pandua W., “Nanotech research methods for foods and bioproducts”, Wiley publications 2012.

AUTOMATION & ROBOTICS IN FOOD PROCESSING

Course Code	20FDB334	CIE Marks	40
Teaching Hours/Week (L:P:SDA)	3:0:0	SEE Marks	60
Credits	03	Exam Hours	03

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

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.

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

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.

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.

Course outcomes:

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

1. To automate many unit operation in food process.
2. To understand Modeling systems.

Question paper pattern:

The SEE question paper will be set for 100 marks and the marks scored will be proportionately reduced to 60.

- 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 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.

Textbook

1. Robotics and Automation in the Food Industry by D Caldwell, Elsevier Science, Woodhead Publishing.
2. Eackman DP. 1972. Automatic Process Control. Wiley Eastern.

Reference Books

1. George Stephanopolous, "Chemical Process Control", Prentice Hall of India, 1990.
2. Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.
3. Considine DM. 1974. Process Instruments and Controls. Mc-Graw-Hill.
4. Thermal Processing of Foods: Control and Automation by K. P. Sandeep March 2011, Wiley-Blackwell.

PROJECT WORK PHASE – 1

Course Code	20FDB34	CIE Marks	100
Number of contact Hours/Week	0:2:0	SEE Marks	--
Credits	02	Exam Hours	--

Course objectives:

- Support independent learning.
- Guide to select and utilize adequate information from varied resources maintaining ethics.
- Guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- Develop interactive, communication, organisation, time management, and presentation skills.
- Impart flexibility and adaptability.
- Inspire independent and team working.
- Expand intellectual capacity, credibility, judgement, intuition.
- Adhere to punctuality, setting and meeting deadlines.
- Instil responsibilities to oneself and others.
- Train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Phase-1 Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.

Seminar: Each student, under the guidance of a Faculty, is required to

- Present the seminar on the selected project orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit two copies of the typed report with a list of references.

The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

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

- Demonstrate a sound technical knowledge of their selected project topic.
- Undertake problem identification, formulation, and solution.
- Design engineering solutions to complex problems utilising a systems approach.
- Communicate with engineers and the community at large in written an oral forms.
- Demonstrate the knowledge, skills and attitudes of a professional engineer.

Continuous Internal Evaluation

CIE marks for the project report (50 marks), seminar (30 marks) and question and answer (20 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

MINI PROJECT

Course Code	20FDB35	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	02	Exam Hours/Batch	03

Course objectives:

- To support independent learning and innovative attitude.
- To guide to select and utilize adequate information from varied resources upholding ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Mini-Project: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

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

- Present the mini-project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills.
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

CIE procedure for Mini - Project:

The CIE marks awarded for Mini - Project, shall be based on the evaluation of Mini - Project Report, Project Presentation skill and Question and Answer session in the ratio 50:25:25.The marks awarded for Mini - Project report shall be the same for all the batch mates.

Semester End Examination

SEE marks for the mini-project shall be awarded based on the evaluation of Mini-Project Report, Presentation skill and Question and Answer session in the ratio 50:25:25 by the examiners appointed by the University.

INTERNSHIP / PROFESSIONAL PRACTICE

Course Code	20FDBI36	CIE Marks	40
Number of contact Hours/Week	2	SEE Marks	60
Credits	06	Exam Hours	03

Course objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

To put theory into practice.

To expand thinking and broaden the knowledge and skills acquired through course work in the field.

To relate to, interact with, and learn from current professionals in the field.

To gain a greater understanding of the duties and responsibilities of a professional.

To understand and adhere to professional standards in the field.

To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.

To identify personal strengths and weaknesses.

To develop the initiative and motivation to be a self-starter and work independently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

Course outcomes:

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

- Gain practical experience within industry in which the internship is done.
- Acquire knowledge of the industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Develop a greater understanding about career options while more clearly defining personal career goals.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Identify areas for future knowledge and skill development.
- Expand intellectual capacity, credibility, judgment, intuition.
- Acquire the knowledge of administration, marketing, finance and economics.

Continuous Internal Evaluation

CIE marks for the Internship/Professional practice report (20 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Semester End Examination

SEE marks for the internship report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

PROJECT WORK PHASE -2

Course Code	20FDB41	CIE Marks	40
Number of contact Hours/Week	4	SEE Marks	60
Credits	20	Exam Hours	03

Course objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organisation, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instil responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes:

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

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.

Continuous Internal Evaluation:

Project Report: 20 marks. The basis for awarding the marks shall be the involvement of the student in the project and in the preparation of project report. To be awarded by the internal guide in consultation with external guide if any.

Project Presentation: 10 marks.

The Project Presentation marks of the Project Work Phase -II shall be awarded by the committee constituted for the purpose by the Head of the Department. The committee shall consist of three faculty from the department with the senior most acting as the Chairperson.

Question and Answer: 10 marks.

The student shall be evaluated based on the ability in the Question and Answer session for 10 marks.

Semester End Examination

SEE marks for the project report (30 marks), seminar (20 marks) and question and answer session (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.