

MASTER OF SCIENCE
Food Technology & Quality Assurance

PROGRAMME STRUCTURE AND SYLLABUS
2019-20 ADMISSIONS ONWARDS

(UNDER MAHATMA GANDHI UNIVERSITY PGCSS REGULATIONS 2019)



EXPERT COMMITTEE IN FOOD TECHNOLOGY AND QUALITY ASSURANCE (PG)

MAHATMA GANDHI UNIVERSITY

2019

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I gratefully take this opportunity to thank all the members for their valuable contributions in drafting the syllabus of Food Technology and Quality Assurance.

BEENA CHERIAN

Chairperson

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M Sc Food Technology & Quality Assurance

(Mahatma Gandhi University Regulations PGCSS2019 from 2019-20 Academic Year)

1. Aim of the Programme

The aim of this course is to enable the graduate to acquire the scientific, technical and professional skills for teaching/research/executive career in the food industry/food research and teaching institutions through an understanding of science of food technology together with a deeper comprehension of food quality assurance.

The expected outcomes are that students acquire and demonstrate:

- Knowledge and competence in the principles of quality assurance and quality management system as they are applied in the food manufacture and distribution to produce safe food , meeting quality and legal requirements.
- Thorough knowledge of chemical, biological and physical principles which underlie food processing, package and storage.
- Ability to apply the principles of chemical analysis, microbiological and statistical control techniques to analyze and assure the quality and safety of food.
- Capacity to undertake research and leading to New Product Development.
- Capacity for critical evaluation, presentation and interpersonal communication skills.

2. Eligibility for Admission

Any student who has bachelor's degree in Biochemistry, Biotechnology, Chemistry, Food Science & Technology, Food Technology & Quality Assurance, Food Science & Quality Control, Home Science with Chemistry (as auxiliary), Microbiology or Life Science stream with a minimum of 50 % marks in aggregate from a recognized University can apply for the M. Sc Food Technology & Quality Assurance Program. SC/ST candidates need only a pass in the qualifying examination. SEBC (Socially and educationally backward class) OEC (Other Eligible Castes) will be given a relaxation of 3% and 5%, respectively in the prescribed minimum marks.

3. Medium of Instruction and Assessment

a) Duration of Course

- The curriculum requirement of M. Sc. Food Technology and Quality Assurance Programme shall consist of a period of 2 academic years as prescribed in the curriculum. The two academic years shall be split into 4 semesters (6 months each).

Examinations will be conducted at the end of each semester in subjects prescribed in the respective scheme of examinations.

b) Mode of Admission

- Selection of candidates will be based on the marks in the Degree examination or rank in the CAP and interview.
- The candidates shall also satisfy the conditions regarding physical fitness as may be prescribed by the University.
- No admission shall be made after 30 working days from the date of commencement of the first semester as per the academic calendar approved by the University
- Weightage of marks for proficiency in NCC/NSS etc and bonus marks for ex-service men applicants and widows and children of Jawans- ex-service men will be given as per the existing rules of admission. Reservation for the candidates with outstanding reports in sports and games shall be allowed as per rules. 3% of the seat under merit quota is reserved for physically challenged candidate. All the above rules will be subjected to the general rules prescribed by Mahatma Gandhi University from time to time

c) Rules for Readmission

- Students who are unable to attend classes on medical grounds after completing the 1st two semesters may be re-admitted to the respective semester along with the subsequent batch.
- Students seeking re-admission shall give a written application to the Principal
- Students who have been removed from the nominal roles due to default in payment of the semester fees shall be re-admitted, subject to the existing rules of the University

d) Curriculum

M. Sc. Food Technology and Quality Assurance Programme under Credit system (CS) consisting of 4 semesters shall extend over a period of 2 years. **Semester** means a term consisting of a minimum of 90 working days, inclusive of examination, distributed over a minimum of 18 weeks of 5 working days, each with 5 contact classes of one-hour duration. A student has to complete a minimum of 80 credits which would be distributed as following.

Core Course

- a. Theory: 44 credits
- b. Practicals : 16 Credits

c. Project : 5 Credits

d. Viva-voce : 3 Credits

Elective Course

a. Theory : 12 Credits

Credit (Cr) of a course is a numerical value assign to paper according to the relative importance of the content of the syllabus of the programme.

‘Course Credit’ One credit of the course is defined as a minimum of 1-hour lecture/ minimum of 2 hours lab /field work per week for 18 weeks in a semester. The course will be considered as completed only by conducting the final examination, regular student shall not register for more than 24 credits and less than 16 credits per semester. The total minimum credits required for completing a PG programme is 80.

‘Programme Core Course’ (PC) means a course that the student admitted to a particular programme must successfully complete to receive the Degree and which cannot be substituted by any other course.

‘Programme Elective Course’ (PE) means a course which can be chosen from a list of elective and a minimum number of courses is required to complete the programme.

‘Programme Project means a regular project work with stated credits on which the student undergoes a project under the supervision of a teacher in the parent department/ any appropriate research centre in order to submit a dissertation on the project work as specified.

‘Academic week’ is a Unit of five working days in which distribution of work is organized from day 1 to 5, with five contact hours of 1-hour duration in each day. A sequence of 18 such academic week constitutes a semester.

Examination: To be conducted as per rules and regulations framed under credit and semester system.

- There shall be University examination at the end of each semester.
Project evaluation and viva voce shall be conducted at the end of the programme only. Project evaluation and viva -voce shall be conducted by two external examiners (for specialized courses one examiner can be opted from the same college itself).
- There shall be one end semester examination of 3 hours duration in each lecture-based course.

- **EVALUATION AND GRADING**

DIRECT GRADING SYSTEM

Direct grading system based on a 7-point scale is used to evaluate the performance (Internal and External examination of students). For all courses (theory & practical)/ semester/ overall programme letter grades and **GPA/SGPA/CGPA** are given on the following scale:

Range	Grade	Indicator
4.50 to 5.00	A+	Outstanding
4.00 to 4.49	A	Excellent
3.50 to 3.99	B+	Very Good
3.00 to 3.49	B	Good (Average)
2.50 to 2.99	C+	Fair
2.00 to 2.49	C	Marginal
Up to 1.99	D	Deficient (Fail)

No separate minimum is required for internal evaluation for a pass, but a minimum C grade is required for a pass in an external evaluation. However, a minimum C grade is required for a pass in course

Grade	Grade Points
A+	5
A	4
B	3
C	2
D	1
E	0

INTERNAL EVALUATION

The internal evaluation shall be based on predetermined transparent system involving periodic written test, assignments and seminars in respect of theory courses and based on written tests, lab skill/ records/ and viva in respect of practical courses. The marks assigned to various components for internal evaluation is as follows.

COMPONENTS OF INTERNAL EVALUATION

All the components of the internal evaluation are mandatory

Theory

Component	Weightage
Assignment	1
Seminar	2
Best Two Test papers (1 each)	2
Total	5

Practical

Components	Weightage
Written/Lab test	2
Laboratory Involvement and Record	1
Viva	2
Total	5

Project -Internal

Components	Weightage
Relevance of the topic and analysis	2
Project content and presentation	2
Project viva	1
Total	5

Comprehensive Viva

Component	Weightage
Course viva (all courses from first semester to fourth semester)	5
Total	5

EXTERNAL EVALUATION

Theory –External

Maximum weight for external evaluation is 30. The maximum weighed grade point is 115.

Pattern of Questions

Questions shall be set to assess knowledge acquired, standard application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. He/she shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type/problem solving type and long essay type questions. Model question paper for each course, is attached after the restructured syllabus.

SL No:	Type of Questions	Weight	Number of questions to be answered
1	Section A	1	8 out of 10
2	Section B	2	6 out of 8
3	Section C	5	2 out of 4

Practical-External

Components	Weightage
Written/Lab test	7
Laboratory Involvement and Record	3
Viva	5
Total	15

Project –External

Components	Weightage
Relevance of the topic and analysis	3
Project content and presentation	7
Project viva	5
Total	15

Comprehensive Viva Voce - External

Component	Weightage
Course viva (all courses from first semester to fourth semester)	15
Total	15

4. Faculty under which the degree is awarded

M.Sc. Food Technology and Quality Assurance

5. Specialization offered, if any

Nil

5. Note on the compliance with the UGC minimum standard for the conduct and award of post graduate degree

Present syllabus is in compliance with UGC minimum standards to award Post Graduate Degree. The present course is intended to provide a platform for talented students to undergo higher studies in the subject as well as to train them to suit the needs of the society. It is ideal if one enjoys Food Technology and would like to use their skills to model future events and risk. It also allows more flexibility to branch out into other areas of Food Technology. The curriculum draws together a variety of subject areas to enable you modulate real world effects and their financial implications.

7. PROGRAMME STRUCTURE

Table 1: Detailed Scheme for the Distribution of Credits and Period of Instruction

Sl.No.	Course code	Title of course	Credit per course	Contact hours per week	Total contact hours for the course	Total credits for the course
First Semester						
1	FQ010101	Introduction to Food Science and Technology	3	3	54	19
2	FQ010102	Basic Biochemistry	4	4	72	
3	FQ010103	Food Microbiology	4	4	72	
4	FQ010104	Food Chemistry	4	4	72	
5	FQ010105	Biochemistry and Microbiology- Practical I	4	10	180	
Second semester						
7	FQ010201	Food Engineering	4	4	72	22
8	FQ010202	Food Analysis and Instrumentation	4	4	72	
9	FQ010203	Food Preservation Technology	3	4	54	
10	FQ010204	Food Additives and Packaging	3	3	54	
11	FQ010205	Food Quality Assurance and Management	4	4	72	
12	FQ010206	Food Additives & Food Preservation-Practical II	4	6	108	
Third semester						
13	FQ010301	Technology of Cereals, Pulses & Oilseeds	4	4	72	23
14	FQ010302	Technology of Milk, Meat, Poultry & Fish	4	4	72	
15	FQ010303	Technology of Fruits &Vegetables	3	3	54	

16	FQ010304	Food Analysis-Practical III	4	6	108	
17	List of elective papers are given in table 2	Elective	4	4	72	
18		Elective	4	4	72	
Fourth semester						
19	List of elective papers are given in table 2	Elective	4	5	90	16
20	FQ010404	Food Processing & Sensory Evaluation- Practical IV	4	6	108	
21	FQ010405	Project Evaluation	5			
22	FQ010406	Course Viva-Voce	3			

Table 2: Detailed Scheme of Instruction of the Elective Courses

No	Course code	Title of course	Exam duration (hours)	Credit per course	Contact hours per week	Total credits for the course
Elective A						
1	FQ800301	Food Biotechnology	3	4	5	12
2	FQ800302	Technology of Beverages	3	4	5	
3	FQ800403	Bakery and Confectionery	3	4	5	
Elective B						
1	FQ810301	Proteomics and Genomics	3	4	5	12
2	FQ810302	Spices and Flavor Technology	3	4	4	
3	FQ810403	Research Methodology and Statistics	3	4	5	
Elective C						
1	FQ820301	Sensory Evaluation and Product Development	3	4	5	12

2	FQ820302	Food Sanitation and Hygiene	3	4	5	
3	FQ820403	Byproduct utilization and Waste Management	3	4	4	

8. SYLLABUS

8.1 FIRST SEMESTER COURSES

1	FQ010101	Introduction to Food Science and Technology
2	FQ010102	Basic Biochemistry
3	FQ010103	Food Microbiology
4	FQ010104	Food Chemistry
5	FQ010105	Biochemistry and Microbiology-Practical I

FQ010101: INTRODUCTION TO FOOD SCIENCE & TECHNOLOGY

Credit: 3

54 Hours

1.Objectives

- To provide an introductory foundation in Food Science and Technology upon which more advanced and specialized knowledge can be built.
- To enable students to apply scientific methods independently

2.Course content

Unit I: Introduction

10hrs

Food: Classification of foods, Health foods, Natural foods, Organic food, Functional food, Nutraceuticals, Specialty Foods, Fast Foods, space foods, food fortification, restoration and enrichment, anti-nutritional factors, GM food and its safety concern Nutritional status of world population, National and international programs for nutritional improvement.

Unit II: Food Properties

10hrs

Constituents of food-Physical (colour, density, specific gravity, temperature, pH, Water activity, Pressure, Viscosity) and chemical properties (moisture content, Acidity, basicity, buffers, molarity, normality, molality, colloidal system) Dispersion phase and continuous phase (sol, gel, foam, emulsion), solution and its properties

Unit III: Principles of Food Preservation

10hrs

Objectives of preservation of food, Methods of preservation of food, modern technological advances in food preservation, factors affecting food production, steps involved in converting a raw harvested material to a preserved product with sound quality

Unit IV: Flavour chemistry

12hrs

Food flavor chemistry, chemical structure and taste, process and reaction flavours, Chemistry of flavor deterioration, Food Toxicology-Naturally occurring plant and animal toxins, food allergens-types and causes

Unit V: Food Safety and Regulation

12hrs

Food Adulteration: Types of adulterants and detection, PFA, ECA, AGMARK, APEDA, MEPDA, GMP, Food safety and Standard Act 2006, ISO (22000FSMS) Food products Standards and specification (Milk, Fruit product, Oils).

3.Recommended Text Books

- Frederick, J.F, 2000, Encyclopedia of Food Science and Technology. Second edition vol 1-4, a widely inter science publication.
- Goldberg, I., 1999 Functional foods, Designer foods, pharma foods and nutraceuticals. An aspen publication, gaitthers burg, Maryland.
- Roday, S., 2008, Food science and nutrition. Third edition, Oxford University Press, New Delhi.
- Khader, V, 2001, Text book of Food science and Technology. Published by India Council of Agricultural Research, New Delhi 110012.

4. Recommended References

- Manay, N.S,2004, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi,
- Srilakshmi, B,2003, Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi
- Reddy Y.S, 2006, Newer concept and applications for food industry. Gene tech Books, New Delhi 110002,

FQ010102: BASIC BIOCHEMISTRY

Credit: 4

72 Hours

1.Objectives

- To serve as a torch to trace the intricate complexities and chemical mysteries of food.
- Enable students to understand the biochemical pathways and the relevance to their lives.

2. Course content

Unit I: Carbohydrates

20hrs

Carbohydrates- Classification, monosaccharides, Structure of glucose, fructose, galactose, mannose, Chemical properties of monosaccharides, Isomerism, Disaccharides- Maltose, Lactose and Sucrose, Polysaccharides- Homo poly saccharides-Starch, glycogen and cellulose, Hetero polysaccharides Digestion and absorption of carbohydrates. Utilization of glucose – Glycolysis, TCA cycle, Pentose Phosphate pathway, Glycogenesis, Glycogenolysis, Gluconeogenesis, Cori cycle. Diabetes mellitus – classification, clinical features and diet management. Oral glucose tolerance test.

Unit II: Lipids

10hrs

Classification of Lipids, Fatty acids -Classification, Triacylglycerols, Phospholipids & Cholesterol. Digestion and absorption of lipids. Metabolism of fatty acid- Breakdown and synthesis. Formation and utilization of ketone bodies.

Unit III: Proteins and Enzymes

20hrs

Amino acids -classification and properties, Metabolism of amino acids- Transamination, Deamination, Urea cycle. Digestion and absorption of proteins. Structural organization of proteins, protein folding. Enzymes-Classification, Activation energy, Active Site, Enzyme specificity, Factors affecting enzyme activity, Enzyme inhibition, Allosteric enzymes and inhibition, Mechanism of enzyme action, Enzyme Kinetics, Cofactor, coenzyme and prosthetic group, Iso enzymes

Unit IV: Nucleic acids

10hrs

Nucleosides and Nucleotides, Structure of ATP, Structure of DNA, types. RNA-Types, structure of tRNA. DNA replication, Translation, Post-translational modifications- Capping and Tailing, Splicing. Protein synthesis, post-translational modifications,

Unit V: Photosynthesis

12hrs

Chloroplast, Structure of chlorophyll, Photosystems-PS I and PS II, Light Reaction-Cyclic and Non cyclic Photophosphorylation, Dark Reaction-Melvin Calvin Cycle Photorespiration, Hatch and Slack Pathway, CAM.

3. Recommended Text Books

- Textbook of biochemistry, Judith G Voet and Donald D voet.
- Harper's Illustrated Biochemistry 30^{ed} 2015 by Victor W. Rodwell , David A. Bender , Peter J. Kennelly.
- Jain, J. L., 2001, Fundamentals of Biochemistry, Fifth Edition, S. Chand and Company Ltd.
- Satyanarayana, U. and Chakrapani, U, 2006, Biochemistry, Third edition, Books and Allied Pvt ltd, Kolkata

4.Recommended References

- Michael Eskin N.A, 1990, Biochemistry of foods, 2nd edn , Academic press
- Abraham White, 1973, Principles of Biochemistry, 5th edn, Mc Graw Hill.
- Berg, J. M., Tymoczko, J. L, 2007 Biochemistry, Sixth edition, W H Freeman and Company, New York.
- Das, D, 1992, Biochemistry, Seventh Edition, Academic publishers, Calcutta.

FQ010103: FOOD MICROBIOLOGY

Credits – 4

72 Hours

1.Objectives

- To throw light into the basics of Food Microbiology
- To acquire an elementary knowledge about physiology of microorganisms, their control and their role in food borne illnesses and food spoilage.

2. Course content

Unit-I Introduction

10hrs

Classification of living system, History & scope of microbiology, Microscopy and specimen preparation, Cell-structure & function of prokaryote and eukaryote. Bacterial recombination- conjugation, transduction and transformation. Fungi- Classification, Structure and reproduction.

Unit-II Control of microorganisms

20 hrs

Control of microorganisms, sterilization principles and techniques, chemical and physical antimicrobial agents. Mechanisms of action of chemical disinfectants, Antimicrobial agents. Measuring effectiveness of antimicrobial agents, phenol coefficient, TDT- Thermal Death Time and DRT-Decimal Reduction Time (D-value, z-value, F-value). Antimicrobial spectrum, drug resistance in bacteria.

Unit-III Microbial Growth & Cultivation

15 hrs

Microbial physiology: Nutrition, growth curve, growth kinetics. Culture media and methods. Cultivation of bacteria. Isolation and identification: staining techniques, motility, colony characteristics, biochemical characteristics and identification for bacteria, Intrinsic parameters & Extrinsic parameters affecting microbial growth in food.

Unit-IV Microbial Spoilage

15 hrs

Spoilage organisms in food and food products. Types of organisms in meat and meat products, sea-foods, fruits and vegetables, milk and dairy products and canned foods. Sampling methods for microbial analysis of foods, Microbial analysis of air, water and food: aerophilic plate count (APC), Coliform count, MPN techniques

Unit-V Food related beneficial & pathogenic micro-organisms

12 hrs

Probiotics and prebiotics, Single Cell Proteins, Microbial production of enzymes added to foods: amylases, invertase, pectolytic enzymes, proteolytic enzymes, Edible fungi. Food borne diseases, pathogens and their control - bacterial infections & intoxications, viral and protozoan infections.

3. Recommended Text Books

- Frazier, W.C. Food Microbiology. 4th edition. Mc Graw Hill. New York, 2008
- Khetarpaul, N. Food microbiology, Daya publishing house, New Delhi, 2009
- Pelczar, H.J. and Rober, D. Microbiology 5th edition Mc Graw Hill. NewYork, 2009
- Prescott, L.M., Harley, J.P. and Klein, D.A. Microbiology. 4th edition McGraw-Hill, NewYork. 1999

4. Recommended References

- Kathleen Park Talaro (2002) Foundations in Microbiology, Fourth Edition, Mc Graw Hill, New York.
- Ananthanarayan R, Jayaram Panicker CK (2009) Text book of Microbiology, Eighth edition, Universities Press Pvt. Ltd., Hyderabad
- Clive De W. Blackburn and Peter J. Mcclury (2002) Foodborne pathogens -Hazards, Risk analysis and control, Woodhead publishing, Ltd, England
- James M. Jay, Martin J. Loessner, David A. Golden (2005) Modern Food microbiology, 7th Edition, Springer.

FQ010104 – FOOD CHEMISTRY

Credit: 4

72 Hours

1. Objectives

- To acquaint various functional chemical constituents in food
- To build a relationship between the dynamic forces of food and the dynamic forces of digestion and growth

2. Course content

Unit I: Introduction

10hrs

Basic constituents of food, water- structure, physical properties, water solute interactions (water binding, hydration and water holding capacity), water activity-definition and measurement, moisture sorption isotherm.

Unit II: Carbohydrates

20hrs

Definition, Classification: monosaccharide, disaccharide, polysaccharide, Isomerization. Starch – structure, gelatinization, Retrogradation, staling, starch types, starch complexes, hydrolysis of starch, Resistant starch. Cellulose – gums, pectins, dietary fiber. Browning reactions: Non enzymatic reactions.

Unit III: Proteins and Enzymes

20hrs

Classification, structure, protein denaturation and denaturing agents, functional properties of proteins in food, protein quality test, changes induced by heating, oxidative changes, crosslinking. Enzymes in foods, modifications of foods by endogenous enzymes, enzymatic browning reactions

Unit IV: Fats and Oils

10hrs

Role of lipids in foods, chemical properties and reactions, lipolysis, rancidity, test for rancidity reversion, hydrogenation, inter esterification and winterization. Fat Characterization. Waxes, chemistry of frying oils, sterols.

Unit V: Vitamins and Minerals

12 hrs

Vitamins-Fat soluble and water soluble vitamins- classification, structure, bio availability, Sources, chemical properties, general causes for losses of vitamins in food. Deficiency disease. Minerals- Classification, Sources, Bioavailability, Functions and deficiency. Major elements-Ca, P, Mg, Na, K, F. Trace elements-Fe, Cu, I, Mn

3. Recommended Textbooks

- Damodaran,S.,Parkin , K L.,Fennema, O R.,1996, Fennema's Food chemistry- 4th edition, CRC press Taylor and Francis Group,New York .
- Meyer, L H,2002, Food chemistry.CBS publishers& distributors, New Delhi.

4. Recommended References

- Fennema, O R. -Food chemistry 3rd edition Replika press Pvt. Ltd.,India
- Campbell, M K and Farrell,2006, S O-Biochemistry 5th edition-international student Edition

FQ010105: BIOCHEMISTRY & MICROBIOLOGY PRACTICAL-I

Credits – 4

180 hrs

1. Objectives

- To provide a balanced introduction to laboratory techniques and principles those are important in the area of Biochemistry & Microbiology

2. Course content

Biochemistry

- Preparation of buffers and Solutions- Concept of Normality and Molarity 5hrs
- Qualitative Test 15 hrs
 - Qualitative tests for carbohydrates
 - Qualitative tests for proteins
- Estimation of proteins 15 hrs
 - Biuret method
 - Lowry's method
- Estimation of Sugar 15 hrs
 - Estimation of Glucose by Dinitro salicylic Acid Method
 - Estimation of Glucose by Anthrone Method
- Estimation of Cholesterol by Zak's Method 10 hrs
- Estimation of ascorbic acid by DNPH method 10 hrs
- Chromatographic analysis of amino acids by Paper Chromatography 10 hrs
- Analysis of Lipids or amino acids by TLC 10 hrs

Food Microbiology

- Methods of cleaning and sterilization 10 hrs
- Culture media 10 hrs
- Culture methods 10 hrs
- Staining techniques- Monochrome staining, Differential staining, Negative Staining, Endospore staining, Volutin Granule staining 15 hrs
- Antibiotic Sensitivity Test 5hrs
- Examination of bacteria for motility 5 hrs
- Characterization of microbial colonies 10 hrs
- Microbiology of milk, MBRT, APC, 10 hrs
- Microbiology of water- MPN 10 hrs
- IMViC Tests 5 hrs

3. Recommended Text Books

- Sadasivam S, Manickam A (1996) Biochemical Methods, Second edition, New Age International Ltd, New Delhi.
- DK (2002) Dubey R C, Maheswari. Practical Microbiology, S. Chand & Company Ltd.,

4. Recommended References

- Pearson, D, 2002 The Chemical Analysis of Foods, Churchill Livingstone, New York,

8.2 SECOND SEMESTER COURSES

1.	FQ010201	Food Engineering
2.	FQ010202	Food Analysis and Instrumentation
3.	FQ010203	Food Preservation Technology
4.	FQ010204	Food Additives and Packaging
5.	FQ010205	Food Quality Assurance and Management
6.	FQ010206	Food Additives & Food Preservation- Practical II

FQ010201: FOOD ENGINEERING

Credit: 4

72Hours

1. Objectives:

- To scale up laboratory methods to manufacturing process
- To understand the operations of food industries as a major functional area.

2. Course content

Unit I: Dimensions, Quantities and Units

10hrs

Dimensions and Units, Basic physical quantities: velocity and speed, acceleration, force and momentum, weight, pressure, work and energy, power. Dimensional analysis: dimensional consistency and dimensional analysis. Phase diagram of water.

Unit II: Heat transfer

15hrs

Heat transfer in food processing: Heating and cooling of food products, Heat Exchangers, Thermal properties of foods, Heat Transfer: Modes of heat transfer, Conduction, Steady state heat transfer, Conduction in rectangular objects, tubular pipe and multilayered systems, Convection, Estimation of convective heat transfer coefficient, forced convection, free convection, Estimation of overall heat transfer coefficient, Insulation, Design of a Tubular heat exchanger, Radiative heat transfer, Black body radiation, Emissivity, Radiation heat transfer between two objects.

Unit III: Fluid mechanics

20hrs

Fluid mechanics: Liquid Transport system, Properties of liquids, Handling systems for Newtonian liquids, Continuity equation, Reynolds number, Velocity profile in a liquid flowing under fully developed flow conditions, Bernoulli equation, Energy equation for steady flow of fluids, Pump selection and performance evaluation, Flow measurement, Measurement of viscosity, Flow characteristics of Non-Newtonian fluids.

Unit IV: Mechanical Operations

15hrs

Mechanical Operations: Mixing and different types of mixers used in food industry, Forming, Size Reduction, Clarification and concentration, Agglomeration. Membrane separation: Electro dialysis systems, Reverse Osmosis, Ultra filtration, Mechanical Separations: Sedimentation, Centrifugation, Filtration. Phase Separations- Distillation and types, Extrusion technology. Chemical Separations: Leaching, Steeping, Extraction, Diffusion Concentration

Unit V: Freezing & Drying

12hrs

Refrigeration: Selection of refrigerant, Components of a refrigeration system, Pressure-enthalpy charts, Mathematical expressions useful in analysis of Vapor-compression refrigeration, Cooling load, Coefficient of performance, Refrigerant flow rate, Use of multistage systems. Freezing: Freezing systems, Direct and indirect contact systems, Evaporation: Types of evaporators, Design of a single and multiple effect evaporator, Vapor recompression systems.

3. Recommended Text Books

- Singh, R.P., 2004, Introduction to Food Engineering 3rd edition. Academic Press, London.
- Heldman, D. R, 2007, and Lund, D.B. Handbook of Food Engineering 2nd edition. CRC press, New York.

4. Recommended References

- Dincer, I, 1997, Heat Transfer Food Cooling Applications. Taylor and Francis Publishers, USA.

FQ010202: FOOD ANALYSIS AND INSTRUMENTATION

Credit: 4

72 Hours

1. Objectives:

- To broaden and deepen the coverage and scope of food analysis.
- To provide an updated and high-quality original contribution on new developments in food analysis and its emerging applications.

2. Course content

Unit I Principles of Analytical Instrumentation

15hrs

Importance of analysis of biomolecules, Sampling, sampling techniques, Basic principles, instrumentation and application of the following – Spectroscopy (UV-Spectroscopy, Visible, Infrared, Atomic Spectroscopy, NMR) Electrophoresis-(SDS-PAGE), Chromatography (Physio-chemical principles, chromatographic techniques-Paper, TLC, HPLC, GLC), Colorimetry, Gravimetry, refractometry.

Unit II Analysis of Carbohydrates

20hrs

Importance of carbohydrate analysis, Extraction of mono and oligosaccharides, Removal of interfering compounds, clarification with lead acetate. Chemical methods for Mono and oligosaccharides: Lane and Eynon Method, Munson and Walker Method, Nelson-Somogyi method, Alkaline ferricyanide method, Phenol-sulphuric acid method, Enzymatic methods for mono and oligosaccharides: D-glucose/D-fructose/D-sorbitol method, Lactose/D-galactose method, Maltose/sucrose/D-glucose method, Raffinose method, Oxidase method. Analysis of starch & fiber

Unit III Analysis of Lipids and moisture

15hrs

Importance of fat analysis, Sample preparation (Pre drying, particle size reduction, acid hydrolysis). Analysis methods: Continuous solvent extraction methods, Gold fish method (procedure and calculation), Semi continuous solvent extraction methods, Soxhlet method (Preparation of sample, Procedure and calculation), Discontinuous solvent extraction methods Modified Mojonnier method. Non - solvent wet extraction methods: Babcock method (principle, procedure, and application), Gerber method (principle, procedure, application). Analysis of Moisture- Oven drying method, Chemical method (Karl Fischer titration), Distillation procedures, physical methods

Unit IV Analysis of Proteins

10hrs

Importance of protein analysis, Methods of analysis (Principle, procedure, application) Kjeldahl Method, Biuret method, Lowry method, Bi-cinchoninic Acid method, Ultraviolet (UV) 280nm Absorption, Dye binding method, Bradford method, Ninhydrin method & Turbidimetric method

Unit V Analysis of Vitamins and Minerals

12 hrs

Importance of vitamin analysis: Extraction methods, Bio assay method for vitamin D Physico - chemical Methods: Vitamin A (Carr – Price method Thiamine by thio chrome method, Riboflavin – fluorometric method, Niacin-colorimetric method, Vitamin D – HPLC method , Analysis of minerals: Microwave digestion. Analysis of the following minerals (Principle and procedure), Calcium – EDTA titration. Phosphorus – colorimetric method. Copper, Iron and zinc by ICP. Vitamins, thiamin and riboflavin, Niacin by colorimetric method. Analysis of ash

3.Recommended Text Books

- Nielsen, S.S, 2004 Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London.
- Sharma, B.K, 2004, Instrumental Methods of Chemical Analysis. Goel Publishing House, New Delhi

4.Recommended References

- Mahindru, S.N, 2000, Food additives. Characteristics, detection and estimation. Tata Mc Graw-Hill Publishing Company Limited, New Delhi.
- Pearson, D, 2002 The Chemical Analysis of Foods, Churchill Livingstone, New York,
- Harry T Lawless, Hildegard Heymann (2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, New York.
- Sarah Kemp, Tracey Hollywood, Joanne Hort (2011) Sensory evaluation: A Practical Hand-book, Wiley-Blackwell, New York

FQ010203: FOOD PRESERVATION TECHNOLOGY

Credit: 3

54 Hours

1. Objectives:

- To provide an exhaustible coverage on all major aspects of food preservation in an easy and acceptable style.
- To nurse our body and promote good health benefits by improved food preservation techniques.

2. Course content

Unit I: Food Spoilage

5 hrs

Definition, factors affecting food spoilage: physical, biological, chemical. Specific spoilage organisms (SSO), Shelf life assessment, Extension of shelf life, Methods for assessment of spoilage, Spoilage indices: physical, chemical and microbiological.

Unit II: Food Preservation by Heat Treatment

15 hrs

Principles of food preservation, need & methods of food preservation.

Pasteurization: Purpose of pasteurization, Types, Water bath pasteurization, continuous steam or water spray pasteurization, Long hold or vat pasteurization, High temperature short time pasteurizers, ultra high temperature pasteurizers, vacreators , Thermal death time relationship: D value, F value and Z value, 12D concept. **Sterilization:** Continuous rotary pressure sterilizer, hydro locks continuous cooker or cooler, hydrostatic pressure sterilizer, continuous pallet sterilizer, fluidized bed sterilization, hot sterilization, flash 18 process. **Canning:** history, Principles of canning, steps involved in canning.

Unit III: Food Preservation by Low temperature treatment

10 hrs

Refrigeration, Principles of refrigeration, mechanism of refrigeration, Change occurring during refrigeration. Chilling injury. Freezing process, principles of freezing, freezing curve, freezing methods: direct contact systems and Indirect contact systems. Cryogenic freezing, freeze drying, dehydro freezing, freezer burn, Thawing and damage caused by intermittent thawing.

Unit IV: Preservation by Removal of Moisture

10 hrs

Drying- Classification of drying. drying curve, factors affecting drying, Thermal drying of foods: Air drying and Low air environment drying. Osmotic dehydration: osmotic process, factors affecting the osmotic dehydration process. Food concentration, methods of concentration, changes during concentration.

Unit V: Potential Food Preservation Methods

14 hrs

Irradiation Preservation in Foods: Food irradiation process, dose and dosimetry, scope of irradiation, special advantages of irradiation, effect of food irradiation on micro organisms and food components and application of irradiation in foods of plant origin and animal origin.

Preserving food with Electricity (Ohmic heating): Definition, heat generation, effect of ohmic heating on foods and food components, applications in food industry. **Microwave heating:**

Principles, Unit of microwave, advantages and disadvantages of microwave, applications of microwave in food industry. **Combined Methods for Food Preservation:** Introduction, Principles of Combined preservation methods (Hurdle effect, hurdle technology, total quality, potential hurdles), application of hurdle technology.

3 Recommended Books

- Shafiur Rahman M.,1999. Hand Book of Food Preservation, Marcel Dekker, Inc, New York
- Srivastava, R.P.O and Kumar, S, 1994, Fruit and vegetable preservation, International Book distribution Company, Lucknow.
- Subalakshmi, G and Udipi, S.A, 2001, Food processing and preservation. New Age International Publishers, New Delhi

4.Recommended References

- Frazier, W.C, 2008, Food Microbiology. 4th edition. Mc Graw Hill. New York.
- Potter, N.N. and Hotchkiss J. H, 1996, Food Science. CBS publishers and distributors.
- Cruess, W.V, 1997, Commercial fruits and vegetable products, Anees Offset press, New Delhi.
- Srilakshmi, B, 2003, Food Science. New Age International Publishers, New Delhi.
- MC.Williams, 1984, M and Paine, H. Modern Food preservation. Surjeet Publications, Delhi.

FQ010204: FOOD ADDITIVES & PACKAGING TECHNOLOGY

Credits: 3

54 Hours

1.Objectives:

- To know the structure and chemical characteristics of chemicals added to food.
- To provide insight into the scope of packaging technology in food industries.

2. Course content

Unit I: Introduction

5 hrs

Functionality of food additives, Objectives of additives. Natural and synthetic additives. Health and safety aspects of food additives. Generally Recognized As Safe (GRAS) and Acceptable Daily Intake

Unit II: Types of food additives

15 hrs

Additive numbering system; Permitted food colours- natural and artificial. Food flavours – natural and artificial. Sweeteners- natural and artificial. Antimicrobials, Antistaling agents, Bodying agents, Clouding agents, Curing agents, Clarifiers, Emulsifiers, Fat replacers, Gelling agents, Leavening agents, Stabilizers, tenderizers, thickeners, antioxidants , chelating agents, flavor enhancers

Unit III: Introduction to packaging technology

12 hrs

Packaging: Primary, secondary and tertiary packaging of foods. Paper board, packaging. Shear strength and compression properties of corrugated cartons, Transportation tests and stacking tests. Packaging materials: tin, tin free steel, aluminum, glass, thermoforming & thermosetting plastics, paper and metal laminations. Packaging material used for dairy products, baked goods, dehydrated foods & fruit juices.

Unit IV: Packaging techniques

12 hrs

Microwave oven safe packaging (susceptron). Aseptic packaging of foods and the developing technology. Tests for packaging. Migration, retorting, Active Packaging, intelligent, shrink and stretch packaging MAP and CAP packaging. Biodegradable packaging materials: their advantages and disadvantages.

Unit V: Food adulteration

10 hrs

Food adulteration, definition, methods of adulteration, methods of detection.

3. Recommended Text Books:

- Richard Coles, Derek McDowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishing, CRC Press LLC, 2003
- Srilakshmi, B., 2005, Food Science., New Age International (P) Limited., New Delhi.
- Subalakshmi, G and Udipi, S.A, 2001, Food processing and preservation. New Age International Publishers, New Delhi.
- Potter, N. N, Hotchkiss, J. H, 2000 Food Science. CBS Publishers, New Delhi.

4. Recommended References

- Manay, N.S, Shadaksharaswamy, M., 2004, Foods- Facts and Principles, New Age International Publishers, New Delhi.
- Mahindru, S N, Food Additives : Characteristics, detection , and estimation , A P H Publishing Corporation, New Delhi.

FQ010205: FOOD QUALITY ASSURANCE AND MANAGEMENT

Credits 4

72 hours

1. Objectives

- To contribute a deep insight to the principles of food quality systems and management of food safety and quality assurance
- To render a basic knowledge in assessment of food quality, hazards impending the food safety and regulation implemented to assure food quality

2. Course content

Unit I: Food Quality Assessment

10hrs

Methods for quality assessment (Sensory, Physical, Chemical & Microbiological) of food materials: fruits, vegetables, cereals, milk & dairy products, meat, poultry, egg and processed food products. Quality Control (QC) System: Importance & functions; Quality Assurance (QA) System: Definition & Importance. Comparison of QC & QA Systems.

Unit II: Hazard Identification & Control

15hrs

Hazards: definition, classification: physical, chemical & biological, Biological- Pathogenic bacteria, viruses, protozoa; Chemical: Naturally occurring toxins and added chemical hazards; Physical hazards: Glass, wood, stones, metal fragments etc. their tolerance & control.

Unit III: Pre-requisite Programs

15hrs

Construction and lay-out of buildings and associated utilities; Lay-out of premises, including workspace and employee facilities; Supplies of air, water, energy and other utilities; Supporting services, including waste and sewage disposal; The suitability of equipment and its accessibility for cleaning, maintenance and preventative maintenance; Management of purchased materials (e.g. raw materials, ingredients, chemicals and packaging), supplies (e.g. water, air, steam and ice), disposals (e.g. waste and sewage) and handling of products (e.g. storage and transportation); Measures for the prevention of cross contamination; Cleaning and sanitizing; Pest control; Personnel hygiene;

Unit IV: Quality management

20 hrs

Total Quality management: Leadership, Customer satisfaction, Employee Involvement, Continuous Process Improvement, Supplier Partnership, Performance Measures. Tools & techniques for TQM: Benchmarking, Quality management System (ISO 9001), Environmental management System (ISO 14001), Quality by Design, Failure Mode & Effect Analysis, Six sigma, Statistical process control

Unit V: Food regulation

12 hrs

Food regulations, grades and standards- Concept of Codex Alimentarius, USFDA, ISO 22000 FSMS. HACCP- Seven principles - HACCP manual, preparation, validation, implementation - Internal audit, verification audit, deficiencies, corrective and preventive actions, consumer complaint . Solid and liquid waste management in food industry - Different Effluent Treatment Systems, COD, BOD, - Organic manure and biogas from solid waste, IPR and patents

3. Recommended Text Books

- Wilbur A Gould (1977) Food quality assurance. 1st Edition, AVI Pub. Co, Westport, Conn. (USA)
- Wilbur A. Gould, Ronald W. Gould (2001) Total quality assurance for the food industries. 3rd Edition, CTI Publication Inc, Maryland, USA
- Besterfield DH, C Besterfield-Michna, Besterfield GH, M Besterfield-Sacre (2007) Total Quality Management, 3rd Edition, Pearson Education Inc.
- Rekha S. Singhal, Pushpa R. Kulkarni, Dinanath V. Rege (1997) Handbook of Indices of Food Quality and Authenticity, 2nd Edition, Woodhead Publishing Ltd, England.

4. Recommended References

- Clive De W. Blackburn and Peter J. McClury (2002) Foodborne pathogens-Hazards, Risk analysis and control, Woodhead publishing, Ltd, England
- James M. Jay, Martin J. Loessner, David A. Golden (2005) Modern Food microbiology, 7th Edition, Springer.
- J Andres Vasconcellos (2004) Quality Assurance for the Food Industry: A Practical Approach, CRC Press
- Inteaz Ali (2004) Food Quality Assurance: Principles & Practices, CRC Press.

FQ010206-FOOD ADDITIVES AND PACKAGING TECHNOLOGY

Credits: 4

108 Hours

OBJECTIVES

To provide knowledge on various methods used for analysis of additives in food and also to gain practical skill in packaging and to determine the efficiency of packaging

Food Additives

1. Estimation of iodine in iodized salt	8 hrs
2. Estimation of Saccharine	8 hrs
3. Estimation of sodium benzoate	8 hrs
4. Estimation of sulphur dioxide	8 hrs
5. Estimation of salt by Mohr's method	8 hrs
6. Estimation of chlorophyll	8 hrs
7. Estimation of carotenoids	8 hrs
8. Estimation of propyl gallate	8 hrs
9. Estimation of sorbic acid	8 hrs
10. Qualitative test for gums	8 hrs

Food Packaging

Testing of packaging materials

• Bursting strength	3 hrs
• Puncture resistance	3 hrs
• Drop test	3 hrs
• Identification of plastics	4 hrs
• Thickness	3 hrs
• Water vapour transmission rate	3 hrs
• Gas transmission rate	3 hrs
• Tear strength	3 hrs
• Migration test	3 hrs

3. Recommended Text Books and References

- Richard Coles, Derek Mcdowell, Mark J. Kirwan, Food Packaging Technology, Blackwell Publishing, CRC Press LLC, 2003
- Mahindru ,S N, Food Additives : Characteristics, detection , and estimation , A P H Publishing Corporation, New Delhi.

4. Recommended References

- Larry Branen, P. Michael Davidson, Seppo Salminen, John Thorngate, Food Aditives, Marcel Dekker Inc., 2002

8.3. THIRD SEMESTER

1.	FQ010301	Technology of Cereals, Pulses & Oilseeds
2.	FQ010302	Technology of Milk, Meat, Poultry & Fish
3.	FQ010303	Technology of Fruits & Vegetables
4.	FQ010304	Food Analysis-Practical III
5.	List of elective papers are given below	Elective
6.		Elective

Elective A		
1	FQ800301	Food Biotechnology
2	FQ800302	Technology of Beverages
3	FQ800403	Bakery and Confectionery
Elective B		
1	FQ810301	Proteomics and Genomics
2	FQ810302	Spices and Flavor Technology
3	FQ810403	Research Methodology and Statistics
Elective C		
1	FQ820301	Sensory Evaluation and Product Development
2	FQ820302	Food Sanitation and Hygiene
3	FQ820403	Byproduct utilization and Waste Management

THIRD SEMESTER

FQ010301-: TECHNOLOGY OF CEREALS, PULSES AND OIL SEEDS

Credits 4

72 Hours

1. Objectives:

- To provide a deep coverage in the processing and manufacturing of food products from cereals, pulses and oil seeds
- To give a general outline about the principles, structure and composition, economic importance and storage of different cereals and their products.

2. Course content

Unit I: Chemistry and Technology of Rice

15 hrs

Rice – Structure of rice grain, Chemical composition, nutritive value and rice classification. Parboiling of rice – traditional and modern methods, advantages and disadvantages of each method of parboiling, properties of parboiled rice and changes during parboiling and Rice milling and its by products (broken grains, rice pollards, rice bran and rice hulls). Drying of rice – ultra low temperature drying, low temperature drying, high temperature drying, ultra high conduction drying, sun drying, forced air mechanical drying and deep fixed bed drying. Ageing and curing of rice.

Unit II: Wheat Chemistry

15 hrs

Wheat-Introduction to wheat chemistry. Structure of wheat grain-chemical composition, nutritive value and its relation to processing qualities. Wheat milling and byproducts of wheat milling. Dough Rheology -basic approaches to dough rheology, influence of flour constituents on dough rheology, Dough testing instruments such as farinograph, mixograph, alveograph, extensograph, amylograph

Unit III : Corn Chemistry

15 hrs

Corn- Structure of corn, Chemical composition and nutritive value. Dry and Wet milling of corn and its byproducts (corn grits, corn meal, corn flour, corn syrup, high fructose corn syrup, corn oil, corn starch, gluten and germ)

Unit IV: Technology of Pulses

15 hrs

Chemical composition and nutritive value of important pulses (ground nut, soya bean, black gram, Bengal gram). Decortications of pulses – soaking, pounding, grinding, roasting, toasting, parching, milling of pulses and puffing. Byproducts of milling - protein isolates. Germination, and agglomeration of pulses. Toxic factors in legumes. Quick cooking legumes, instant legume powders and legume protein concentrates

Unit V: Oilseed Technology

12 hrs

Chemical composition and nutritive value of oilseeds, processing of edible oil—rendering, pressing, and solvent extraction. Methods of oil refining – deodorization, hydrogenation, winterization, randomization and interesterification. Toxic factors in oilseeds and role of oilseeds in cookery.

3.Recommended Text Books:

- Mats A.S. The chemistry and technology of cereal as food and feed;2nd edition ; CBS publications; New Delhi;1996
- Faridi ,Dough Rheology and baked products texture; CBS publications, New Delhi;2000
- Pandey,P.H; principles and practices of postharvest technology. kalyani publishers, Madras;2000

4.Recommended References

- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004.
- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Subbulakshmi. G and Udipi S.A; Food Processing and Preservation; New Age International, New Delhi,2001

FQ010302: TECHNOLOGY OF MILK, MEAT, POULTRY AND FISH

Credits 4

72 Hours

1. Objectives:

- To provide a knowledge on the composition, nutritive value and uses of dairy and flesh foods.
- To broaden and deepen the coverage of production, processing and utilization of each food related to Indian and Continental cuisine

2. Course content

Unit I : Introduction to Dairy Technology

15 hrs

Definition, types of milk and their composition (cows, buffalo, goat, human) factors affecting composition of milk, food and nutritive value, physicochemical properties of milk- acidity and pH, density and specific gravity, freezing point, color and flavor, manufacture, packaging and storage of pasteurized milk. Judging and grading of milk, flavor defects of milk and their causes and prevention. **Special Milks** - definition, methods of manufacturing of sterilized milk, homogenized milk, flavored milk, Vitaminised milk, irradiated milk. Frozen concentrated milk, fermented milk, standardized milk, reconstituted/rehydrated milk, recombined milk, toned, double toned milk.

Unit II: Dairy Products

15 hrs

Cream, Butter, Cheese (Cheddar and Cottage cheese), Condensed Milk, Ice cream and Dried Milk Definition, classification, composition, method of manufacture, defects and uses. Indigenous milk products- Paneer, Chhana, Khoa, Chakka, Shrikhand, Kulfi, Lassi, Rabri, Basundi, Dahi and Yoghurt

Unit III: Meat Technology

15hrs

Structure and composition of meat, nutritive value of meat, abattoir practices and slaughter methods, stunning methods, ante and post mortem changes in meat. Meat pigments, Meat tenderization, different meat cuts. Packaging of meat- Cryovac method, chamber method, thermoforming method. MAP of meat. Meat preservation methods. DFD and PSE Meat. Meat products: Method of manufacture – sausages, ham, bacon and minced meat

Unit IV : Technology of Fish and fish products

15 hrs

Classification of fish, nutritional composition, Methods of preserving fish- freezing, canning, salting, smoking, drying and pickling and irradiation. Sea food toxins- ciguatera toxins, shell fish. Poisoning, puffer fish toxins, scombroid poisoning. Fish products: fish meal, fish flour, fish oil, fish protein concentrates, minced fish technology and Surimi, fish glue, fish hydrolysate.

Fish byproducts: ising glass, gelatin, chitin, chitosan, fish albumin, shark fin rays, squalene and collagen

Unit V : Poultry Technology and products

12hrs

Poultry: Poultry processing and poultry meat products. Egg: formation, structure, nutritive value, chemical composition, egg grading; preservation of egg: pasteurization, freezing, drying, refrigeration and its products

3.Recommended Text Books

- Sukumar De; 2000; outlines of Dairy Technology, oxford University press, New Delhi.
- Indian standards specifications, Indian standard Institution, Manak Bhavan, New Delhi.
- Lampert L.M;1999; Modern Dairy products, Eurasia publishing House(p)Ltd,New Delhi
- Winton&Winton;1999; Milk and Milk products; Agro Bios,New Delhi
- Winton &Winton; 1999 Fish and Fish products ;Agro Bios, New Delhi

4.Recommended References

- Cutting.L.C.1999.Fish processing and preservation Agro Botanical publishers ,New Delhi
- Iyer, T.S; 2000; Quality Assurance in sea food processing;CIFT,Cochin.
- Panda P.C; 1998; Textbook on Egg and Poultry Technology,Vikas publishers.
- Pearson A.M Gillet T A;2000; Processed Meats, New Delhi

FQ010303: TECHNOLOGY OF FRUITS AND VEGETABLES

Credits 3

54 hours

1. Objectives:

- To provide a knowledge on the pre- and post-harvest technology of fresh fruits and vegetables
- To introduce the emerging trends in minimal processing of fruits and vegetables.

2. Course content

Unit I : Introduction

10 hrs

Definition of fruits, Nutritive value and Pigments (Water soluble and insoluble pigments), organic acids, enzymes, flavor compounds and bitter compounds. Anti-nutritional and toxic factors, health benefits of fruits and vegetables. Stability of nutrients – chemical changes, flavor changes, changes in nutritive value (Physical and biological changes). Post harvest losses in fruits and vegetables- definition of post harvest loss, factors affecting post harvest losses – primary causes (mechanical injury, pathological action and environmental factors) and secondary causes. Control of post harvest losses – cultural operations, harvesting and field handling, newer packaging, improved transportation, reducing moisture loss and chemical treatments. Freezing injury, chilling injury and heat injury

Unit II :Maturity, ripening and harvesting of fruits and vegetables

10 hrs

Ripening – Changes during ripening, Classification of fruits – climacteric and non climacteric fruits. Maturity indices and its importance, determination of harvest maturity indices – Computational methods, physical methods, chemical methods and physiological methods. Harvesting of fruits and vegetable- manual and mechanical methods and mode of transportation

Unit III: Packing house operations and storage

12 hrs

Post harvest operations and its methods – reception, drenching, washing, cleaning, pre-cooling (ice cooling, room cooling, forced air cooling, hydro cooling and vacuum cooling), trimming, presorting, sorting/ grading (by size and color), waxing (types, specifications, applications and methods), physical treatments (hot water treatment, vapor heat treatment, ionizing radiation), chemical treatments, packaging and labeling. Storage-factors affecting storage, methods of storage – Traditional storage (on site storage, pit storage, high altitude storage, clamp storage, under-ground storage and evaporative cool storage) and improved storage methods (refrigerated storage, MAP, CAP, active packaging, passive atmosphere modifications, silicone membrane technology, vacuum packaging, hypobaric storage)

Unit IV: Processing of fruits and vegetables**12 hrs**

Peeling (knife peeling, lye peeling, flash steam peeling, abrasion peeling and flame peeling), slicing/ dicing, blanching – factors influencing blanching, methods of blanching (hot water blanching, steam blanching, individual quick blanching, blanching with hot water and steam system, vacuum steam blanching, in can blanching , microwave blanching and hot gas blanching) and nutritional quality of blanched food. Canning of fruits and vegetables and nutritional retention of canned fruits and vegetables

Unit V : Emerging trends in minimal processing of fruits and vegetables**10 hrs**

High Hydrostatic Pressure Technology, Oscillating Magnetic Field, High intensity pulsed electric field, Pulse Light Technology, Ultraviolet light technology, Ultra sound technology, Applications of ozone in fruit processing, Electrolysed water treatment, edible coatings, multilayer coatings, osmotic membrane coatings, Enzyme maceration

3.Recommended Text Books

- Post Harvest Technology of Horticultural Crops; K. P. Sudheer, V. Indira; Series – 7; New India Publishing Agency; 2007.
- David Arthey;. Fruit processing .second edition,2001;springer publishers
- Girdhari lal; siddappa G.S.tandon G.L; 1999; preservation of fruits and vegetables ICAR, New delhi

4.Recommended References

Achaya, K.T; 1986, every day Indian processed foods; national book trust India

Desrosier, N.W; 1999; Technology of food preservation, the Avi publishing co, west fort.

FQ010304: Food Analysis-Practical III

Credits: 4

108 hours

1. Objectives

To provide a knowledge and training on principles and techniques for analysis of food composition

2. Course content

- Analysis of honey 10hrs
Moisture, total sugar, acidity, Qualitative test
- Analysis of squash 10hrs
TSS, Ash, Acidity, Total sugar, Ascorbic acid
- Analysis of jams 10hrs
Insoluble solids, Sugar: reducing & non-reducing, Acidity, Pectin
- Analysis of milk 10hrs
Total solids, Ash content, Fat analysis- Gerber method. Protein: sorenson's formol titration. Lactose, Adulteration test
- Analysis of milk powder 6hrs
Moisture, Acidity, Protein, lactose, Fat
- Analysis of condensed milk 10hrs
Acidity, Total solids, Fat, Lactose, Sucrose, Adulteration tests
- Analysis of butter 12hrs
Moisture, Acidity, Salt content, Fat, Saponification value, RM, P, K values.
- Analysis of tea 10hrs
Moisture, ash content, water soluble ash, alkalinity, tannin content, Adulteration tests
- Analysis of coffee 10hrs
Moisture, ash, caffeine, extractives, adulteration tests
- Analysis of beer 10hrs
Carbon dioxide content, alcohol content & acidity
- Analysis of vinegar 5hrs
Total solids, total acidity, non volatile acidity, qualitative tests
- Analysis of wheat flour 5hrs
Moisture, ash content, alcoholic acidity, acidity, sedimentation value, gluten content.

3. Recommended Text Books

- Sadasivam, S. Manickam, A. Biochemical Methods, 2nd edition. New Age International (P) Limited, New Delhi. 2001
- Pearson, D 2002. The Chemical Analysis of Foods; Churchill Livingstone, New York

4. Recommended References

- Nielsen, S.S. Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London 2003

8.4. FOURTH SEMESTER COURSES

1.	List of elective papers are given in table 2	Elective
2.	FQ010404	Food Processing & Sensory Evaluation- Practical IV
3.	FQ010405	Project Evaluation
4.	FQ010406	Course Viva-Voce

Elective A		
1	FQ800301	Food Biotechnology
2	FQ800302	Technology of Beverages
3	FQ800403	Bakery and Confectionery
Elective B		
1	FQ810301	Proteomics and Genomics
2	FQ810302	Spices and Flavor Technology
3	FQ810403	Research Methodology and Statistics
Elective C		
1	FQ820301	Sensory Evaluation and Product Development
2	FQ820302	Food Sanitation and Hygiene
3	FQ820403	Byproduct utilization and Waste Management

FQ010404: FOOD PROCESSING-PRACTICAL IV

Credits:4

108 Hours

Objectives

- To study the principles and methods of preservation of fruits and vegetables into various products and to practically gain skill in development of these products.

1.	Preparation of Dehydrated fruits and Vegetables (Moisture content on dry basis & wet basis) are calculated	15hrs
2.	Preparation of Jam by using Pearson's square method	15hrs
3.	Processing of Guava jelly by using Pearson's square method	10hrs
4.	Processing of RTS and Squash by using Pearson's square method	10hrs
5.	Processing of fruit preserve Required result should contain desired total soluble solids 68 ⁰ Brix	10hrs
6.	Preparation of Candy Required result should contain desired total soluble solids 75 ⁰ Brix	15hrs
7.	Preparation of Tomato puree and Ketchup of desired quality (Specifications)	13hrs
8.	Extraction of Tomato juice by hot break and cold break method Comparison of yield	10hrs
9.	Preparation of IMF	10hrs
10.	Visit to Canning industry	

NB: All results should be analyzed with Sensory Evaluation by Hedonic scale

3.Recommended Text Books

- Srivastava, R.PO and Kumar, S. Fruit and vegetable preservation, International Book distribution Company, Lucknow, 1994.
- Srilakshmi, B. Food Science. New Age International Publishers, New Delhi, 2003.

4.Recommended References

- Subalakshmi, G and Udipi, S.A. Food processing and preservation. New Age International Publishers, New Delhi, 2001.
- Girdhari Lal, Siddappa G.S., Preservation of fruits and Vegetables.,1998

ELECTIVES

ELECTIVE A
FQ800301: FOOD BIOTECHNOLOGY

Credits 4

72 Hours

1. Objectives

To acquire an elementary knowledge about the aspects of applications of biotechnology to food products

2. Course content

Unit I: Fundamentals of Biotechnology

10 hrs

DNA, Replication, Transcription and protein synthesis. Concepts of recombinant DNA technology, Restriction endonucleases, Plasmid vectors, Purpose of gene cloning, Gene cloning and production of recombinant proteins.

Unit II: Fermentation technology

20 hrs

Fermentation-Definition, Bioreactor-Design, Types of fermentation process, batch fed batch and continuous bioreactions, biotransformation, stability of microbial reactors, analysis of mixed microbial populations, specialized bioreactors (pulsed, fluidized, photo bioreactors etc.) Role of fermentation in food biotechnology. Downstream processing: introduction, removal of microbial cells and solid matters, foam separation, precipitation, filtration, centrifugation, cell disruption, liquid-liquid extraction, chromatography, membrane process, drying and crystallization, effluent treatment

Unit III: Fermented Foods

10 hrs

Fermented foods made from cereals--Ogi,Koko. Mahewu: Fermented foods made from cassava-Garri, Foo-Foo, Chickwaungue, Kokote, lafun, cinguada: Fermented foods made from Legumes-Soya bean-Soy sauce, Miso, Natto, Sufu, Tempeh: Idli, Ugba, Iru, Oncom: Fermented foods made from milk-Yoghurt, Kefir, kumiss, Acidophilous milk : Fermented beverages-beer, ale, Lager, sake, perry, wine, cider, toddy, chicha, Kombuch

Unit IV: Food Industry and Applications of Biotechnology to Food Products

12 hrs

Characteristics of food industry. Food manufacturing and processing, objectives of food processing, Yeast-Based Processes and Products- Yeast, bread, wine, beer and Industrial alcohols. Bacteria-Based Processes and Products LAB, Cheese and types of cheese; Fermented meat and fish products; Vinegar and organic acids (Lactic acid, acetic acid, Citric acid); Biomass; Polysaccharides-Microbial, Bacterial and other polysaccharides Enzymes, Sweeteners, flavors and amino acids, Vitamins and pigments, Mushrooms, Bacteriocins, Functional foods and nutraceuticals

Unit V: Genetically modified Plant and animal products

20 hrs

Transgenesis, GMO, (microorganisms, plants, animals and their products), Genomic Basics for Food Improvement, Genetic Modification of Plant Starches for Food Applications, Plant Oils for Food Uses, Nutraceutical Enrichment of Food Crops, Biotechnological Approaches to Improve Nutritional Quality and Shelf Life of Fruits and Vegetables, Solution to Peanut Allergy, Recombinant Lipoxygenases and Oxylipin Metabolism in Relation to Food Quality, Production Traits in Farm Animals, Recombinant milk, Transgenic Fish Technology in Sea Food Production, Fish Protein Hydrolysates, International Aspects of the Quality and Safety Assessment of Foods Derived by Modern Biotechnology, Patenting Inventions in Food Biotechnology

3.Recommended Text Books

- Modern Food Microbiology by James M Jay, Aspen Publishers.
- Essentials of Food Sciences Vickie A. Vaclavik, Elizabeth W. Christian, Springer.
- Food Science by N. Potter & Hotchkiss, ASPEN Publication.
- An introduction to Food Science by Rick Parker and Delmar, Thomson Learning.
- Food Technology by N W Desroisier, Springer.
- Food Science & Nutrition by Sunitha Reddy, Publishing House Pvt. Ltd., Delhi.
- Enzymes in Food Processing by Paramjit S Paneswar, IK Intl. Ltd.
- Food Biotechnology by Kalidas Shetty, Gopinadhan Paliyath, Anthony Pometto Robert E. Levin, Taylor & Francis
- Biotechnology-Fermented foods and their processing by Naduka Okafor

4.Recommended References

- Food microbiology by William C Frazier and Westhoff Dennis C, Tata McGraw Hill publication.
- Food Biotechnology by J Polak, J Tramper and S Bielecki, Elsevier Science
- Food Science & Food Biotechnology by Gustavo F & Lopez, CRC Press.
- Food Engineering by Dennis Heldman & R Paul Singh, Academic Press.
- Food Biotechnology by Kalidas Shetty. CRC Press

FQ800302: TECHNOLOGY OF BEVERAGES

Credits 4

72

Hours

1. Objectives

- To introduce the technology behind the processing of beverages and knowledge on various types of beverages.
- To emphasize the importance of carbonated alcoholic and non-alcoholic beverages.

2. Course content

Unit I : Alcoholic Beverages

20 hrs

Beer making, fermentation process, ingredients, different types of beers, lager, pilsner, ale, stout, porter, role of hops in beer making. Wine making, history, science and technology, Types- White wines, Red wines, Dry wine and Sweet wine, Champagne and sparkling wines, Distilled liquors: Whisky, composition, alcoholic contents and properties, Scotch whisky, Irish whisky and their origin, Canadian whisky, Rum, source and contents, Gin, source and contents, Brandy, contents and properties, Vodka, source and contents

Unit II : Carbonated Beverages

20hrs

Ingredients; Carbohydrates, High-intensity sweeteners, Flavorings, Acids, colors, preservatives and other additives, Syrup room operation: Syrup room design. Syrup room equipment. Syrup room materials, storage and handling. Syrup room CIP systems and detergents, Containers and closures; Carbonation and filling; Carbonators. Proportioners. Fillers. Container inspection equipment, Secondary and tertiary packaging.

Unit III: Mineral water

10hrs

Product types, water sources, bottling materials required, other requirements, consumer choice, water treatments, filtration methods, deionising, additions, substitutions, bottling, shelf life, microbiology of bottled water.

Unit IV: Tea

10hrs

History of tea, chemical constituents of tea, steps involved in processing- Plucking of leaves, Handling, Withering, Rolling, fermentation, drying, sorting, blending, standardizing, packaging,

Unit V: Coffee

12hrs

Composition, Volatile and Nonvolatile compounds in coffee, Roasting of coffee and changes during coffee roasting, Bean behavior, Heat and mass transfer during roasting,

Decaffeination of coffee, different methods of decaffeination, Instant coffee processing, Health effects of Coffee.

3. Recommended Text Books

- David Arthey; Fruit Processing; Second Edition, 2001; Springer Publishers.
- Schapira J;1999; The Book of Coffee and Tea; St. Martins, New York
- Wellman, F.L;1999.Coffee, Intersciences Publishers; New York
- Potter, N. N, Hotchkiss, J. H. Food Science. CBS Publishers, New Delhi. 2000.

4. Recommended References

- Srilakshmi, B. Food Science (3rd edition), New Age International (P) Limited Publishers, New Delhi, 2003.
- Manay, N.S, Shadaksharaswamy, M., Foods- Facts and Principles, New Age International Publishers, New Delhi, 2004
- Subbulakshmi. G and Udipi S.A; Food Processing and Preservation; New Age International, New Delhi,2001

FQ800403: BAKERY & CONFECTIONERY

Credits: 4

90 Hours

1. Objectives:

- To highlight the processing methods used in baking & confectionery industries
- To know about the various types of food products made using baking technology & able to start small scale bakery & confectionery Unit

2. Course content

Unit I: Baking Technology

20hrs

Major baking ingredients and their functions, role of baking ingredients in improving the quality of bread. Characteristics of flour used for making bread, biscuits and cakes. Ingredients used for bread manufacture, methods of mixing the ingredients, dough development methods – straight dough, sponge dough, moulding, proofing, baking and packaging, spoilage, bread staling, methods to reduce bread staling and spoilage.

Unit II: Bakery Products

15hrs

Technology of bread, biscuit and cakes – manufacturing method, function of ingredients, defects and packaging requirements

Unit III: Confectionery Science and Technology

15hrs

Introduction, present trends in the industry. Ingredients. Sugar boiled confectionery, crystalline and amorphous confectionery, Stages of sugar cookery: Rock candy, Hard candy, Fondants and Creams, Marshmallows, toffee, lollypop, honeycomb candy, Caramel and Fudge.

Unit IV: Cocoa processing

20hrs

Cocoa production, chocolate processing, chemical composition, quality control, manufacture of chocolate beverages. Chocolates. Sweet chocolate, Milk chocolates, white chocolate, wafer coated chocolates, cocoa butter, Fat bloom, cause and effect on quality, ways to store chocolate and candies. Cocoa and cocoa powder, low fat cocoa

Unit V: Coconut processing

20hrs

Coconut industry, Introduction, potential products from coconut palm, Copra manufacture, grades of copra, quality standards. Methods of Manufacture, traditional sun drying, smoke drying, hot air modern dryers, proximate composition of copra, methods for coconut oil extraction, machinery associated with oil manufacture. Product specifications: coconut milk cream manufacture and preservation, Moulded coconut sugar, Desiccated coconut, spray dried coconut milk powder, packed tender coconut water, vinegar from coconut, alcoholic beverage, other products from coconut

3.Recommended Text Books

- Zhou. W, Hui Y,H;(2014), “Bakery Products Science And Technology” ,2nd Edition, Wiley Blachwell Publishers,

4.Recommended References

- Pylar, E. J and Gorton, L. A (2009), “Baking Science and Technology” Vol.1 Fourth Edition, Sosland Publications
- Stanley P. Cauvain, Linda S. Young, (2008) “Baked Products: Science Technology and Practice” John Wiley & Sons Publishers

ELECTIVE B
FQ810301: PROTEOMICS AND GENOMICS

Credit: 4

72 Hours

1. Objectives

- To provide an introductory foundation in proteomics and genomics upon which more advanced and specialized knowledge can be built.
- To enable students to apply scientific methods independently

2. Course content

Unit I: Introduction to Genome and gene structure

12hrs

History of genome projects, Gene families, Functional domains, Transcriptomics, Proteomics, Bio-databases

Unit II: Genomics, sequencing techniques and applications

15hrs

Structure and organization of prokaryotic genomes. Transcriptional regulators of bacterial genes. Transposable genetic elements in bacterial genomes. Evolution of bacterial operons and operonisation. Islands and segments of pathogenicity and resistance. Structure and organization of eukaryotic genomes Repetitive and transposable elements and their effect on genome. Telomeric and sub telomeric regions in chromosomes CpG methylation and gene silencing. Yeast-two-hybrid system. cDNA microarrays. Evolution and structure of mitochondrial genomes. Genome sequencing: whole shotgun genome sequencing. Sequencing technology: Sanger capillary sequencing, Roche 454 (pyrosequencing), Illumina/Solexa, Solid System. Pros and cons of sequencing techniques. Maxam-Gilbert sequencing - ORF and promoter predictions. Intron and exon predictions. Gene annotation. Major genome databases. - Bacterial genome atlas BacMap and its applications, Gene finding, Promoter identification, Next-Generation sequencers, Sequencing strategies and the shotgun method, Massive parallel sequencing, TFBS analysis

Unit III: Technologies in proteomics I

15hrs

Tools being used in proteomics and their strengths and weaknesses (1-D & 2-D gel electrophoresis and mass spectrometry-based approaches) Fundamentals of mass spectrometry (basic theory, ionization techniques and mass analyzers, electrospray ionization (ESI) and matrix adsorption laser dissociation ionization (MALDI) and triple quadrupole (QQQ) Reversed-phase HPLC and Microcapillary LC, protein and peptide separation technique) Qualitative and quantitative proteome analysis Short-gun proteomics for proteome profile (whole proteome and

sub-proteome analysis) Expression proteome analysis (isotope-labeling and label-free approaches)
In-vivo proteome analysis

Unit IV: Systems biology and protein data interpretation **15hrs**

Networks analysis, Protein-protein interactions, Protein-DNA interactions, Enhancement of Omics data interpretation by network modeling: Protein identification and analysis tools Post-protein database search tools Data preprocessing, Identification of differentially expressed proteins, Identification of cellular represented by detected proteome and Network modeling for prediction of key regulators

Unit V: Bioinformatics **15hrs**

Bioinformatics and its application. - Major online databases. Practical use of databases. DNA, RNA, proteins in bioinformatics. Amino acid classification. - Similarity, homology, local and global sequence alignment. Scoring matrices (PAM, BLOSUM), Pairwise alignment. Dot sequence alignment. BLAST. Types of BLAST. How to use BLAST. FASTA. ClustalW. BOXSHADE.

3. Recommended Text Books

- T D. Nelson, K E. Fraser, C M. *Microbial Genomes*. Usa: Humana Press, Inc., 2004.
- Heyer, L Campbell, A. *Discovering Genomics, Proteomics And Bioinformatics*. Usa: Cold Spring Harbor Lab. Press, 2006.

4. Recommended References

- Cvrčková, F. *Úvod Do Praktické Bioinformatiky*. Česko: Academia, 2006.
- Aebersold R, Mann M., Mass Spectrometry-Based Proteomics. *Nature*. Mar 13; 422(6928):198-207, 2003.

FQ810302: SPICES & FLAVOR TECHNOLOGY

Credits 4

72

Hours

1. Objectives:

- To give a broad introduction to the formulation, origins, analysis and performance of flavors
- To provide an understanding of all aspects of flavour, in the food, the production chain, the perception by consumers and their contentment during and after eating

2. Course content

Unit I :Spices- form, function & application

15hrs

Spice: Types and composition : Fresh Whole Spices, Dried Spices , Spice Extractives, Essential (Volatile) Oils, Oleoresins (Non volatiles and Volatiles), Other Spice Extractives, Storage Conditions with Spices.Functions of spices: Primary Function of Spices : Flavor, Taste, Aroma, and Texture, Coloring Secondary Functions of Spices: Preservatives, Antimicrobials, Antioxidants.Spice Applications: Marinades, Rubs, and Glazes, Spice Blends, Seasonings, and Condiments

Unit II: Post harvest technology of spices

15hrs

Harvesting, Transport, Threshing, Drying, Cleaning, Packaging & Storage of spices (Seeds & fruits; leaves & stems, flowers & buds, roots & rhizomes, bark, wood & resins)

Unit III: Pest control

12hrs

Pest control methods, decontamination techniques in spices: Irradiation, magnets, Sifters, Air tables, De-stoners, Air separators, Indent separator Spiral gravity separators, Sterilization of herbs and spices.

Unit IV: Flavor technology

15hrs

Formation of flavors in foods such as fruits & vegetables, Changes in food flavoring due to processing, Flavor analysis: Identification & isolation of flavoring materials, Methodology of flavor evaluations, Synthetic flavoring agents, Problems involved in their incorporation in foods, Standards and specification for flavor

Unit V: Flavoring agents

15hrs

Natural flavoring materials: Herbs & Spices, Derivatives of Spices, Artificial flavoring materials, Flavoring materials made by processing: Roasting, Process flavors: Meat-Like Flavors, enzymatically derived flavorings, Flavors made by Fermentation, Flavors made by Pyrolysis: Smoke Flavors, Production of Natural Flavoring materials by Microbial Action.

3. Recommended Text Books

- Reineccius G (2006) Flavor chemistry and technology, 2nd Edition, Taylor & Francis, New York
- J.S. Pruthi; 2000: Quality assurance in spices and spice products: Allied publishers limited; New Delhi.
- Reineccius G: 1999; Flavor chemistry and technology- Health: CBS publishers; New Delhi.
- Reineccius G; 1999; Source book of flavors; 2nd edition, CBS publishers: New Delhi.

4. Recommended References

- Minifie B. W; 1998; Chocolate Cocoa and Confectionary; CBS publishers; New Delhi.
- Schapira J; 1999; The book of coffee and tea; st: Martin's press; New York.
- Wellmon F. L; 1999; Coffee; Inter Sciences Publishers; New York
- Susheela Raghavan (2007) Handbook of Spices, Seasonings, and Flavorings, 2nd Edition, Taylor & Francis, New York
- Peter K V, (Ed.), (2001) Handbook of Herbs & Spices, Vol-1, Woodhead Publishing Ltd, England.
- Peter K V, (Ed.), (2004) Handbook of Herbs & Spices, Vol-2, Woodhead Publishing Ltd, England.
- Peter K V, (Ed.), (2006) Handbook of Herbs & Spices, Vol-3, Woodhead Publishing Ltd, England.

FQ810403: RESEARCH METHODOLOGY & STATISTICS

Credit: 4

90 Hours

1. Objectives

- To understand the significance of research methods and statistics in research.
- To understand the types, tools and methods of research and develop the ability to construct data gathering instruments appropriate to the research design
- To understand and apply the appropriate statistical techniques to analyze numerical data and draw inferences.

2. Course content

Unit I: Introduction to Research Methodology

15hrs

Introduction to Research- Definition, Objectives and Characteristics of research, Types of Research- Basic, Applied and Action research, Exploratory and Descriptive, Ex-post facto research

Unit II: Defining the Research Problems

20hrs

Identification of Research Problem Sources of research problem, Criteria for the selection of research problem. Research design, Rationale, Statement of problem, Setting objectives. Definition of concepts, operational definition, variables ñ independent and dependent, control and intervening variables, limitations and delimitation. Hypothesis - Meaning and importance, types of hypotheses.

Unit III: Sampling Design

15hrs

Sampling Population and Sample, Sampling techniques, Size of sample, Merits and Limitations of sampling, Sampling and Non sampling errors.

Unit IV: Research Methods and Tools

20hrs

Methods of Collecting Primary Data - Questionnaire, preparation of schedules, interview method, case study method, experimentation method, sources of secondary data. Editing and Coding the Data Organization of Data - Classification - meaning and objectives, types of classification. Representation of Data - Diagrammatic and graphical representation - significance of diagrams and graphs - general rules for constructing diagrams - types of diagrams, graphs of time series, graphs of frequency distribution. Interpretation and Report Writing-Meaning of interpretation, precautions and essentials for good report, footnotes and bibliographical citations. Methods - Survey, observation, interview, experimental, clinical methods. Tools, Questionnaire, Schedule (for interview and observation) Rating Scales, Attitude Scales. Reliability and validity.

Unit V Applied Statistics

20hrs

Applied statistics–Methods of collecting data, representation of data, Measures of central tendency – mean, median, mode, Measures of dispersion: range, standard deviation, variance,

Coefficient of variation, Standard error and sources of error, Correlation analysis, Regression analysis, Probability, Theoretical distributions-Normal, Binomial & Poisson, Test of significance: Students t-test, Chi-square Test and Goodness of fit, ANOVA, Design of Experiments.

3.Recommended Text Books

- Kothari, C.R. (2000) Research Methodology- Methods and Techniques, 2nd edition, New age International (P) Ltd. Publishers, New Delhi,
- Batnagar, G.L. (1990): Research Methods and Measurements in Behavioural and Social Sciences, Agri. Cole Publishing Academy, New Delhi.

4.Recommended Text Books

- Bandarkar, P.L. and Wilkinson T.S. (2000): Methodology and Techniques of Social Research. Himalaya Publishing House, Mumbai.
- Mukherjee, R. (1989): The Quality of Life: Valuation in Social Research, Sage Publications, New Delhi.
- Gupta, S.F., (2002). Statistical methods, Sultana Chand and Sons, 31 Revises Edition,

ELECTIVE C

FQ820301: SENSORY EVALUATION AND PRODUCT DEVELOPMENT

Credits 4

72Hours

1.Objectives

- To enlighten the students on the fundamental aspects of sensory science
- To provide an updated knowledge on sensory measurements and various sensory factors affecting subjective evaluation

2.Course Content

Unit I: Introduction

12hrs

Subjective evaluation, sensory evaluation: definition, and applications and sensory attributes of food: Appearance, texture and flavor; difference between objective and subjective evaluation, sensory perception: mechanism of taste, smell, retronasal smell, somethesis, kinethesis, chemesthesis- pepper heat, carbonation, metallic taste etc. mechanism of color perception

Unit II: Sensory evaluation requirements

15hrs

Requirements of sensory evaluation: sensory laboratory design, sensory booths, sensory panels- types of panels, requirements, recruitment criteria & selection, training. Sample preparation and serving procedures such as sample size, sample serving temperature palate cleansers, swallowing and expectoration, score card, sensory scaling- line scales, numeric scales, hedonic scales

Unit III: Sensory measurements

15hrs

Kinds of sensory tests- difference:- triangle, duo-trio tests, paired comparison tests, descriptive tests:- texture profile, flavor, profile, affective tests:- preference test, ranking test, hedonic tests. Factors affecting sensory measurements:- psychological – expectation error, mutual suggestion effect, distraction error etc; physiological : adapation, mixture interactions- enhancement, synergy, & suppression, health and environmental factors.

Unit IV: Food texture and appearance

15hrs

Definition, kinds of texture: visual texture, auditory texture- crunchiness, crumbliness, oral tactile texture- size and shape, mouth feel, phase changes, oral crispiness, crumbliness and crunchiness, hand tactile feel, texture measurement- texture profile, instrumental texture measurements.

Food appearance :

Normal human color vision mechanism and color blindness, measurement of appearance such as turbidity, glossiness, translucency, visual color measurement, instrumental color measurement: muncell color solids, tri-colorimetry, standard observer, mathematical color systems such as CIE.

Unit V: Product Development and Plant Layout

15hrs

Plant Layout-Introduction, Definition, types of plant layout, objectives and advantages, Product Development-Definition, Objectives and need of product development, Stages in product Development, Reasons of Failure, Types and steps of product development, Product development tools and their reuse

3. Recommended Text Books

- Harry T Lawless, Hildegarde Heymann (2010) Sensory evaluation of Food: Principles and Practices, Second Edition, Springer, New York
- Sarah Kemp, Tracey Hollywood, Joanne Hort (2011) Sensory evaluation: A Practical Handbook, Wiley-Blackwell, New York
- Nielsen, S.S, 2004 Introduction to the chemical analysis of foods. Jones and Bartlett Publishers, Boston, London.

6. Recommended References

- Srilakshmi, B .2005 .Food Science., New Age International (P) Limited., New Delhi
- Anil kumar S, Poornima SC, Abraham NK & Jayasree K 2004; Entrepreneurship Development, New Age International Publishers

FQ820302: FOOD SANITATION AND HYGIENE

Credits 4

72hours

1.Objectives

- To know the principles and applications of sanitation in food industry.
- To know about the various types of Sanitation techniques applicable in the food industry
- To gain an understanding of food hygiene, sanitation and safety during food processing Unit operations.

2.Course content

Unit I: Sanitation and Health

10hrs

Definition, importance of sanitation, application of sanitation to food industry and food service establishments. Microorganisms and sanitation, Normal flora Vs pathogens, Sources of food contamination, Origin and chain of infection, control of microbial growth in food.

Unit II: Sanitation Methods and procedures

20 hrs

Sanitizers, types, chemical properties of sanitizers, Mechanism of activity, Soil, Types of soil, Substrates, biofilms, sanitizing methods, sanitation equipment's and systems sanitation and cleaning procedures, pest control, insects, rodents and other pests, Evaluation of sanitation procedures

Unit III: Hygiene and food handling

15 hrs

Hygienic Food handling and personal hygiene, Hand washing, safe food, food storage, sanitary procedures in food preparation, Food service control points, Hygiene Monitoring Test (HMT), serving and displaying of food

Unit IV: Sanitation in food industry in food industry

12hrs

Dairy processing plant sanitation, Beverage plant Sanitation, Meat and Poultry plant sanitation, Sea food plant sanitation, Fruit and Vegetable processing plant sanitation.

Unit V: Sanitation regulations and Standards

15 hrs

Sanitary Design and Construction for food processing, Role of HACCP in sanitation, Sanitation program and Quality Assurance, sanitation regulatory agencies, control of food quality, local health authority. Food sanitation check lists. Management and sanitation, safety at work place

3. Recommended Text Book

1. Marriott, Norman (2013), “Principles of Food Sanitation”, Springer Science & Business Media Publishing.
2. Roday S, (2011) (2002), “Food Hygiene and Sanitation”, McGraw Hill Publishing Company Limited.

4.Recommended References

3. H. L. M. Lelieveld, John Holah, David Napper, (2014), “Hygiene in Food Processing: Principles and Practice”, Elsevier Publications.

FQ820403: BYPRODUCT UTILIZATION AND WASTE MANAGEMENT

Credits 4

90hours

1.Objectives

- To identify types of wastes in food industry
- To gain knowledge in different effluent treatment methods
- To utilize the byproduct in the food industry

2.Course content

Unit I: Introduction

15 hrs

Types of waste and magnitude of waste generation in different food processing industries, concept, scope and importance of waste management and effluent treatment.

Unit II: Waste characterization

20hrs

Temperature, pH, Oxygen demands (BOD, COD, TOD), fat, oil and grease content, metal content, forms of phosphorous and sulphur in waste waters, microbiology of waste, other ingredients like insecticide, pesticides and fungicides residues

Unit III: Effluent Treatment

20 hrs

Pretreatment of waste: sedimentation, coagulation, flocculation and floatation Secondary treatments: Biological- oxidation ponds, trickling filters, activated sludge process, Anaerobic sludge digesters, Tertiary- Chlorination, Ozonation, Reverse Osmosis, industrial wastewater treatment: characteristics of industrial wastewater, treatment levels

Unit IV: Waste utilization of agro industries

20 hrs

Characterization and utilization of byproducts from cereals (breweries), pulses, oilseeds, fruits & vegetables (wineries) and plantation crops (sugar industries).

Unit V: Waste utilization of animal and marine product industries

15hrs

Characterization and utilization of byproducts from dairy, eggs, meat, fish and poultry

3.Recommended Text Books

1. Abbas Kazmi, Peter Shuttleworth, (2013), "The Economic Utilisation of Food CoProducts", Royal Society of Chemistry Publishing.
2. A.M. Martin, (2012), "Bioconversion of Waste Materials to Industrial Products", Springer Science & Business Media Publishing

4.Recommended References

3. Marcos von Sperling,(2007), "Basic Principles of Wastewater Treatment", IWA Publishing.

9. MODEL QUESTION PAPERS

M. Sc Degree (C.S.S) Examination

First semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010101- INTRODUCTION TO FOOD SCIENCE & TECHNOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Comment on organic foods?
2. What are functional foods?
3. What do you mean by nutraceuticals? Explain any five nutraceuticals?
4. What is the importance of nutritional labeling to the consumer and manufacturer?
5. Bio-fortification is superior to fortification. Explain?
6. Why do astronauts require special foods?
7. Write on health foods.
8. What you mean by fortification?
9. Define water activity?
10. Write on health food.

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. What are GMF discuss its advantages and disadvantages?
12. Explain the mandatory measures to check the quality of foods?
13. Give an account of nutrition labeling?
14. Give a brief note on retort processed foods?
15. Write brief note on PFA
16. Comment on foods related to obesity.
17. Describe food allergens.
18. Describe about national and international programs for nutritional improvement.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Write in detail about the food safety standards, its functions and regulations?
20. Discuss different nutritional disorders in humans and their remedial measures.
21. Define the term water activity (a_w). List factors influencing a_w in food Discuss the role and significance of a_w in food preservation.
22. Emerging trends in food technology?

M. Sc Degree Examination

First semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010102- BASIC BIOCHEMISTRY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

((Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Competitive and Noncompetitive inhibition?
2. What do you mean by Inversion of sucrose?
3. Mention the structure and role of t-RNA.?
4. What is GTT?
5. Define oxidative phosphorylation.?
6. PSI and PS II?
7. Give structure and function of ATP?
8. What is protein folding?
9. What are nucleosides?
10. Differentiates aldose and ketose?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Explain Glycolysis?
12. Elaborate the structure of DNA?
13. Describe Urea cycle?
14. Enzyme Kinetics?
15. Explain light reaction of photosynthesis?
16. Photorespiration?
17. Transamination?
18. Pentose phosphate pathway is called as HMP Shunt. Why. Give its significances?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Describe the citric acid cycle. Indicate the controlling points and energetics for citric acid cycle?
20. Elaborate Melvin-Calvin cycle?
21. Explain the bio-synthesis of fatty acid with structure?
22. Comment on protein synthesis with the help of appropriate diagrams?

M Sc Degree (C.S.S.) Examination

First semester

Branch: Food Technology and Quality Assurance

FQ010103- FOOD MICROBIOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. What do you mean by resolution of a microscope?
2. What is phenol coefficient?
3. Mention the role of lipopolysaccharides in gram negative bacteria?
4. What is differential media?
5. Define Z-value?
6. What is meant by thermal death time?
7. What are SSO?
8. What are chemotrophs?
9. What is differential media. Give examples?
10. Define lyophilization?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weight)

11. Point out the differences between probiotics and prebiotics?
12. Give an account of bacterial endospore and its formation?
13. Discuss about sterilization by filtration?
14. Comment on growth curve?
15. Spoilage of sea foods?
16. Economic importance of yeast?
17. Role of enzymes in food industry?
18. Give an account of different modes of transmission of infection?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Classify the chemical disinfectants. Explain the mode of action of disinfectants?
20. Describe the reproduction of fungi?
21. Give an account of food poisoning?
22. Write in detail about SCP, their production and advantage?

M. Sc Degree (C.S.S) Examination

First semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010104-FOOD CHEMISTRY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8×1= 8 weights)

1. Distinguish between free water and bound water?
2. Briefly explain iso-electric pH of the protein?
3. What is saponification?
4. Write short note on shortenings?
5. What is fortification?
6. Write general structure of mono, di and tri glycerides?
7. Describe the functional properties of protein
8. Write a note bioavailability of vitamins and minerals?
9. What is reversion?
10. Define moisture sorption isotherm?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

11. Discuss various applications for enzymes in food industry?
12. Explain the role of trace minerals and supplements in human diets?
13. What is rancidity, different types and its prevention?
14. Define Maillard's reaction and its practical application in food?
15. Explain briefly the effect of pH on enzyme reactivity?
16. Explain protein denaturation with suitable examples?
17. Discuss about naturally occurring enzyme inhibitors?
18. Explain the chemical properties of fat?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Explain types of browning reaction and recommended modes of inhibition?
20. Define rancidity and flavour reversion, what are the factors affecting development of rancidity and flavour reversion?
21. What are carbohydrates? Describe the classification of carbohydrates with example?
22. How do you classify lipids? Define significance of saponification value of oils and fat?

M. Sc Degree (C.S.S) Examination

First semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010105-BIOCHEMISTRY & MICROBIOLOGY PRACTICALS-I

(2019 Admission onward)

Credit 4

Maximum Weight: 15

1. Identify the given bacteria culture by Gram staining ? 2 weights
Principle-0.5 weight
Procedure- 0.5 weight
Result-1 weight
2. Perform bacterial motility? 2 weights
Principle- 0.5 weight
Procedure- 1 weight
Result- 1.5 weights
3. Write down the principle and procedure of estimation of ascorbic acid by DNPH method?
Principle - 0.5 weight Procedure – 0.5 weight 1 weights
4. Estimation of amount of unknown protein in the sample by Lowry's method? 3 weights
Principle- 0.5 weight
Calculation and Graph-1.5 weights
Result- 1 weight
5. Identify the mixture of 2 sugars present in the given sample? 3 weights
6. Check the quality of milk by MBRT method? 1 weight
7. Viva-voce 2 weights
8. Certified record 1 weights

M. Sc Degree (C.S.S) Examination

Second semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010201- FOOD ENGINEERING

(2019 Admission onward)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. State Stefan Boltzmann's law?
2. Define Kick's law?
3. Describe reverse osmosis?
4. Describe the refrigeration cycle?
5. Distinguish between single effect and multiple effect evaporators?
6. What is filtration?
7. Differentiate between leaching and extraction?
8. What is Bernoulli's theorem?
9. Discuss the mode of heat transfer?
10. Define Newton's law of viscosity?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. What is freezing? Describe different phenomenon occurring during freezing of foods with the help of time-temperature curve?
12. Describe drum drying with neat diagram and examples?
13. Define Reynold's number and Prandl number and explain its significance?
14. Express Bernoulli equation stating significance of each term involved?
15. What is spray drying? Describe the method with neat diagram?
16. Define convection and explain how forced convection differ from natural convection?
17. What are the effects of process variation on membrane filtration?
18. Explain the role of insulation in reducing heat from process equipment with a suitable example?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5 = 10)

19. Describe different types of heat exchangers with schematic diagram citing an example?
20. Mechanism of refrigeration?
21. Explain velocity profile of a thick fluid flowing through a pipe?
22. Derive an expression for heat transfer through composite wall consisting of four layers?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010202: FOOD ANALYSIS AND INSTRUMENTATION

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8×1= 8 weights)

1. Define sampling?
2. Give the importance of sampling?
3. What do you mean by food rheology?
4. Give the principle of refractometry?
5. What do you mean by crude fiber?
6. Define carbohydrates?
7. Write a note on plasma ashing?
8. State Beer- Lambert's law?
9. Write the difference between chromatography and electrophoresis?
10. What is refractive index. Explain its significance in food?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

11. Explain on types of sampling?
12. Explain on crude fiber analysis?
13. Give biuret method?
14. Define ash, important procedure involved in dry ashing?
15. Principle and procedure of Gerber method?
16. Explain the bioassay method for vitamin D?
17. How will you estimate amino acids by Ninhydrin method?

18. What is iodine value. Write its significance in oil analysis.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Explain the methods of fat determination?
20. Write down the principle and procedure involved in the EDTA titration of calcium?
21. Comment on different types of chromatographic techniques?
22. Explain in detailed on estimation of protein by Kjeldahls method and draw a neat diagram on it?

M. Sc Degree (C.S.S) Examination

Second semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010203- FOOD PRESERVATION TECHNOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Major applications of irradiation in food industry?
2. Differentiate between pasteurization and sterilization?
3. Cite out the importance of FD Valve?
4. Write a brief note on water activity?
5. What is the role of salt and sugar as a preservative?
6. Enlist the causes of food spoilage?
7. Differentiate between sharp and quick freezing?
8. Explain the term freeze drying?
9. What is the significance of exhausting in canning industry?
10. What is cryogenic freezing?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

11. Explain osmotic dehydration and add a note on factors affecting osmotic dehydration?
12. Explain the principle of microwave with diagram?
13. Explain ohmic heating and factors affecting ohmic heating?
14. Explain about different types of freezing?
15. Write brief note on sterilisers used in food industry?
16. Elaborate on different techniques of thermal drying?
17. Explain factors affecting spoilage?
18. Explain the mechanism of refrigeration?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Describe the principles of Hurdle technology and their applications?
20. Explain the principles and methods for canning?
21. What is irradiation? Mention the sources and mode of action of radiation in food commodities?
22. How will you assess the concentration of foods and mention the changes during assessment of food concentration?

M. Sc Degree (C.S.S) Examination

Second semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010204- FOOD ADDITIVES & PACKAGING TECHNOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. What do you mean by aseptic packaging?
2. Comment on the flavour enhancer responsible for chinese restaurant syndrome?
3. Define the term food additives?
4. Are food laws essential, if so why?
5. What does GRAS mean?
6. What are permitted food colours used according to PFA act?
7. What are biodegradable packaging materials?
8. Expand LLDPE?
9. What do you mean by intelligent packaging?
10. Brief note on collapsible tubes?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Write a brief note on natural and artificial food colorants?
12. Write a note on MAP and CAP?
13. What is corrosion in tin plate cans? Explain the factors responsible for corrosion?
14. Explain briefly the method for detection of adulterants in milk?
15. Give an account on any four types of food additives used in food industry?
16. Explain the mechanism of microwave heating?
17. Narrate the role of anti-oxidants in food processing?
18. Explain the requirements of effective packaging?.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Define food packaging and explain the functions of packaging?
20. What are dietary fibres? How are they classified? Mention their role in human metabolism?
21. Give an account on different types of corrugated fiber boards, their advantages, disadvantages and applications?
22. Write short notes on
 - (a) Chelating agents
 - (b) Fat replacers
 - (c) Sodium benzoate
 - (d) emulsifiers

M Sc Degree (C.S.S) Examination

Second semester

Branch: Food Technology and Quality Assurance

FQ010205: FOOD QUALITY ASSURANCE & MANAGEMENT

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Define 'Quality control'?
2. What is a patent?
3. What is a hazard?
4. Define bactericide?
5. Give a brief note on cluster sampling?
6. Define selective media?
7. What is peroxide value?
8. Define CCP?
9. Explain the term TQM and ISO?
10. What is GMP?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. What are pre-requisites of sampling?
12. Comment on IPR?
13. Explain lagooning?
14. Give short note on Clostridium botulinum?
15. List the seven principles of HACCP?
16. Differentiate between validation and verification?
17. Write notes in control chart?
18. Brief note on Exo and Endotoxin?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. What are the features of Quality control?
20. Discuss the major levels in hygienic plant design?
21. Write on different methods for sampling foods?
22. What are the pre-requisite programs implemented in food industry?

MSc Degree (C.S.S) Examination

Second semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010206: Food Additives & packaging technology-Practical II

Maximum weights: 15

1. Write down the principle and procedure involved in the estimation of iodine in iodized salt? (2 weights)
 - a) Principle-
 - b) Procedure-

2. Estimate the amount of salt in the butter by using Mohr's salt method? (2 weights)
 - a) Principle
 - b) Method
 - c) Result

3. Estimate the amount of sodium chloride in the given sample? (3 weights)
 - a) Principle
 - b) Method
 - c) Result

4. Detect the packaging materials by appropriate tests. Write down the procedures?
 - a) Procedure (2 weights)
 - b) Result

5. Write down the procedure of Bursting strength, drop test and Puncture resistance (2 weights)

6. Viva (2 weights)

7. Certified Record (2 weights)

M. Sc Degree (C.S.S.) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010301: TECHNOLOGY OF CEREALS, PULSES & OIL SEEDS

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8 × 1 = 8 weights)

1. Brief note on rice pollards?
2. What do you mean by refining of oil?
3. Abbreviate and expand on HFCS?
4. What do you mean by hominy feed?
5. What is 'parching' of pulses?
6. What are lectins?
7. What do you mean by the term gelatinization?
8. What is popcorn?
9. List some of the cereal based puffed products.
10. What is haemagglutination?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6 × 2 = 12 weights)

11. How gluten is formed and explains its role in cereal cookery?
12. Explain the structure of wheat kernel with diagram?
13. Discuss on anti nutritional factors present in oilseeds?
14. Explain the manufacture of corn starch?
15. Distinguish between Winterization and Hydrogenation?
16. Describe the processing steps of corn?
17. Give a brief account on parboiling of paddy?
18. Report the factors affecting the cooking quality of legumes.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Explain the different steps in rice milling and discuss about the byproducts of rice milling?
20. Describe the different methods of extraction of oils from oilseeds? And explain the processing steps of oil?
21. Explain in detail about decortications and milling of pulses?
22. Explain in detail about corn milling?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010302: TECHNOLOGY OF MILK, MEAT, POULTRY AND FISH

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8×1= 8 weights)

1. Difference between ham and bacon?
2. What is curing of meat?
3. Explain the terms-
 - a) Yolk index
 - b) Haugh Unit
 - c) Candling of egg
4. What do mean by poaching in egg?
5. Define surumi
6. What is meant by homogenized milk?
7. What do you mean by thermo stabilization?
8. What are the basic difference between red and white meat
9. List the reason for fish spoilage
10. Report on proteins in egg white.

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Explain the different steps involved in the manufacture of sausage?
12. Mention the different types of preservation methods used in eggs?
13. Write in brief about marine food toxins?
14. Comment on the manufacturing methods of vitaminised milk?
15. Give short note on stunning methods prior to slaughter?
16. How fish protein concentrates are manufactured?
17. Preparation of ghee?
18. Poultry is classified on the basis of age. Elaborate the statement with the reference to different groups.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Explain the steps involved in the manufacture of ice-cream? And write note on over run in ice cream?
20. Give an outline of processing of pasteurized milk with a labeled sketch?
21. Explain briefly about the different types of fish byproducts?
22. Explain the ante-mortem and post mortem aspects of slaughter animals?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010303: TECHNOLOGY OF FRUITS & VEGETABLES

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Differentiate between climacteric and non-climacteric fruits?
2. Mention the pigments present in fruits?
3. PEF?
4. OMF?
5. What do you mean by hypobaric storage?
6. Lye peeling?
7. Differentiate between freezing injury and Chilling injury?
8. Distinguish between thermosonication and manothermosonication?
9. Report on Enzyme maceration?
10. Antinutritional factors present in fruits and vegetables?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12weights)

- 11 Describe the different methods of pre-cooling used for fruits?
- 12 Explain the maturity indices to judge the ripening of fruits?
- 13 Describe HPP with the help of a diagram. List its merits and demerits and applications
- // 14 Describe the methods of storage of fruits and vegetables?
- 15 Modes of transportation of fruits and vegetables
- 16 Discuss the process of canning of fruits
- 17 Narrate the different types of waxing in fruits and state its importance
18. What are the different methods of blanching foods.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Explain post-harvest losses in fruits and vegetables?
20. Define ripening and explain the changes occurring in fruits during ripening?
21. Elaborate the chemical composition in fruits and vegetables
22. Explain in detail about the non-thermal methods used in fruit processing?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010304 : Food Analysis-Practical III

Maximum weights: 15

1. Write down the principle and procedure involved in the estimation of glucose by Willstatter's Iodometric method?
 - A) Principle
 - B) Procedure

(3 weights)
2. Determine the peroxide value of the given sample?
 - a) Principle
 - b) Method
 - c) Result

(3 weights)
3. Estimate the amount of sodium chloride in the given sample?
 - a) Principle
 - b) Method
 - c) Result

(2 weights)
4. Detect the adulterant in the given sample by appropriate tests. Write down the procedures
 - a) Procedure
 - b) Result

(2 weights)
6. Determine the acid value of the given sample?
 - i. Principle
 - ii. Procedure
 - iii. Result

(2 weights)
5. Viva

(2 weights)
6. Certified record

(1weights)

M. Sc Degree (C.S.S) Examination

Fourth semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ010404: Food Processing & Sensory Evaluation- Practical IV

Time: 3 hours

Maximum weights: 15

1. Explain the detail about the preparation of jelly? (2 weights)
Method
Result
2. Prepare the different stages of sugar cookery? (3 weights)
Method
Result
3. Estimate the amount of acidity in given sample? (2 weights)
Principle
Method
Result
4. What are the sensory methods used to evaluate the quality of foods & perform the product by using triangle test? (3 weights)
5. Dehydration of carrot. Find out the dehydration ratio & reconstitution ratio? (2 weights)
6. Viva (2 weights)
7. Certified Record (1 weight)

M. Sc Degree (C.S.S.) Examination

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ800301: FOOD BIOTECHNOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

- 1 Starter culture?
- 2 Golden rice?
- 3 Sake?
- 4 SSF?
- 5 Plasmid vectors?
- 6 Garri?
- 7 Non-nutritive sweeteners?
- 8 LAB?
- 9 GMO ?
- 10 Restriction endonucleases?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

- 11 Write a note on specialised bioreactors?
- 12 Brief note on GM food?
- 13 Fermented foods from soyabean?
- 14 Explain the genetic modification done in peanuts to combat peanut allergy?
- 15 Describe the production of citric acid?
- 16 Give a brief account on various types and modes of fermentation?
- 17 Explain the technology of transgenic fishes and its significance to sea food industry?
- 18 Write a short note on batch fed and continuous biofermentation?.

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Describe Baker's yeast and its applications in baking and brewing. Add a note on genetic modification of baker's yeast?
20. Describe the process of gene cloning and production of recombinant proteins ?
21. Define Downstream processing. Explain in detail about various steps involved in downstream processing?
22. What is GMO? Give a detailed account of GM plants, animals and microorganisms?

M. Sc Degree (C.S.S.) Examination

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ800302: TECHNOLOGY OF BEVERAGES

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

- 1 High Intensity Sweeteners?
- 2 Withering?
- 3 Instant Coffee Processing?
- 4 Components in tea?
- 5 Differentiate between cocoa butter and butter fat?
- 6 Differentiate between gin and vodka?
- 7 Hops?
- 8 Lager?
- 9 Oolong tea?
- 10 Cocoa mass?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

- 11 What is the difference between CTC and orthodox tea?
- 12 Write note on decaffeination of tea?
- 13 Explain the manufacturing process of wine?
- 14 Explain the water treatment methods used in beverage industry?
- 15 Describe the production of citric acid?
- 16 Give a brief account on quality control of tea?
- 17 Explain the processing of cocoa?
- 18 Write a note on Flavour substances in tea?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

- 19 Describe on roasting and the changes occurring during roasting of green coffee?
- 20 Describe alcoholic and non-alcoholic beverages?
- 21 What are the chemical changes occurring during fermentation of green coffee?
- 22 What are the steps involved in beer making

M. Sc Degree (C.S.S) Examination

Fourth semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ800403: BAKERY & CONFECTIONERY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Milk chocolate?
2. Rock candy?
3. Grades of copra?
4. Preparation of marsh mallows?
5. Fat bloom?
6. Knock back?
7. Conching?
8. Fudge and fondant?
9. Cocoa butter?
10. Milk chocolate?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Manufacture of Coconut chips?
12. What are different stages of sugar cookery?
13. Give a note on spray dried coconut milk powder?
14. Discuss the methods in cashew nut processing?
15. Manufacture of cake?
16. Processing of cocoa ?
17. Dough rheology?
18. Colors and flavors used in confectionery?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Classification of confectionary?
20. Explain the process of bread making?
21. Discuss in detail about the methods of manufacture of copra, grades of copra and different drying methods?
22. Manufacture of chocolate ?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ810301: PROTEOMICS AND GENOMICS

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Define proteomics?
2. ORF?
3. BLAST?
4. CpG Methylation?
5. Reversed phase HPLC?
6. Transposable genetic elements?
7. Bio database/?
8. Define CpG island?
9. FASTA?
10. PAM?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. What are the major online data bases and their practical uses?
12. Describe about protein-protein and protein-DNA interactions?
13. Explain the qualitative and quantitative proteomics analysis?
14. Give an account of TFBS analysis?
15. Give a brief note on scoring matrices?
16. Write brief note on Bac map and its applications?
17. Comment on gene families?
18. Explain homology modelling?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Write in detail on different protein identification tools?
20. Discuss different genome sequencing methods ?
21. Explain the theory and working of mass spectrometry. Add a note on different ionization techniques and analyser?
22. What are different types of BLAST. Comment on its use and applications?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ810302: SPICES & FLAVOR TECHNOLOGY

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8×1= 8 weights)

- 1 Write a note on oleoresin?
- 2 What are the primary functions of spices?
- 3 Give detail on Packaging and storage of spices?
- 4 Distinguish between oleoresins and essential oils
- 5 Short note on lactones?
- 6 Comment on HVP?
7. Enzymatically derived flavorings
8. Antioxidants properties of spices.
9. Adulterants in spices
10. Short note on Spiral gravity separators?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

- 11 Explain the main factors influencing maillard reaction?
- 12 Explain the manufacture of oleoresins?
- 13 Describe the problems involved in the addition of synthetic flavoring agents?
- 14 Briefly explain Autolyzed Yeast Extract?
- 15 What are the pest control methods of spices?
- 16 Which are the standards and specifications for flavors?
- 17 Describe the quality control methods and standards of any 2 spices?
- 18 How will you identify and isolate the flavoring materials in fruits and vegetables?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Describe the formation of flavors compounds via Maillard Reaction?
20. Define the term flavor and explain its changes during processing. ?
21. What are the flavor constituents in spices? Briefly describe the mechanism of isolating the flavor constituents from spices by illustrating an example?
22. Elaborate on the decontamination techniques used in spice industry?

M.Sc. Degree (C.S.S) Examination

fourth semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ810403 RESEARCH METHODOLOGY & STATISTICS

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. What do you mean by hypothesis?
2. Explain different types of sampling?
3. What are the major sources of secondary data?
4. Comment on Questionnaire?
5. What is chi-square?
6. Types of diagram?
7. Null hypothesis?
8. Differentiate mean and mode?
9. Define research?
10. Define variables?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Write a brief note on types of research?
12. What are the criteria for the selection of research?
13. What are the merits & demerits of sampling?
14. Explain briefly on methods of surveys?
15. Give an account on measure of central tendency?
16. Details on classification of data?
17. What are the major objectives and characteristics of research?
18. Explain any two positional averages with suitable examples?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5 = 10)

19. Write a note on hypothesis & its types?
20. What are the methods of data collection?
- 21.** How to interpret & report writing for good research?
- 22.** Explain various Sampling techniques?

M Sc Degree (C.S.S) Examination

Third semester

Branch: Food Technology and Quality Assurance

FQ820301 SENSORY EVALUATION AND PRODUCT DEVELOPMENT

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

- 1 What are carriers?
- 2 How hedonic test is performed?
- 3 How is the sensitivity of an individual measured?
- 4 What is shortometer? Describe its principle with examples?
- 5 Define standard observer?
- 6 Write a brief note on expectation error?
- 7 Give out a short note on visual texture?
- 8 Sensory parameters chartered for conducting sensory evaluation?
- 9 Triangle test?
- 10 What are the major colorblindness observed in human?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

11. What is score card? Explain its importance in sensory evaluation?
12. What are the factors affecting food acceptance?
13. Describe the importance of triangle tests in sensory evaluation and how it is carried out?
14. What do you mean by taste booths? What are the salient features of it?
15. Detail CIE system?
16. Describe objectives of product development?
17. Describe the physiological factors which affect sensory measurement?
18. What are the major attributes of texture?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2 × 5= 10 weights)

19. Present in brief about classification of sensory test methods?
20. What are the criteria to be remembered while selecting taste panels required for sensory evaluation?
21. What are the factors affecting sensory measurements?
22. Explain different steps involved in product development and describe tools involved in product development?

M. Sc Degree (C.S.S) Examination

Third semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ820302: FOOD SANITATION AND HYGIENE

(2019 Admission onwards)

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. Differentiate between cleaning, sanitation, disinfection and sterilization?
2. Cross flow filtration?
3. HMT?
4. Quats?
5. CIP and COP?
6. Three compartment sink process?
7. Normal microflora?
8. Types of biosensors used for pathogenic detection?
9. Thermal death kinetics?
10. Solid waste in food industry?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6×2= 12 weights)

11. What is the role of HACCP in sanitation?
12. Describe Origin and chain of infection?
13. Explain the mandatory measures to check the sanitation of foods?
14. Give an account of different methods of sanitation?
15. Give a brief note on sanitation procedures applied in diary processing plant?
16. Write brief note on sanitation regulatory agencies?
17. Comment on sources of contamination of food.
18. Write a brief note on biofilms?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2× 5= 10 weights)

19. Describe in detail the sanitation procedures adopted in a Beverage plant?
20. Discuss Sanitation design and construction adopted for meat industry?
21. Discuss the methods equipment's and mechanism of sanitation. Add a note on different types of sanitizers?
22. Discuss the pest control measures adopted in food industries. Also add a note on the types of pest?

M. Sc Degree (C.S.S) Examination

Fourth semester

Faculty of Science

Branch: Food Technology and Quality Assurance

FQ820403: BY PRODUCT UTILIZATION AND WASTE MANAGEMENT

Time: 3 hours

Maximum Weights: 30

Section A

(Answer any **eight** questions. Each question carries a weight of 1)

(8× 1= 8 weights)

1. BOD and COD?
2. Flocculation?
3. Sewage?
4. Eutrophication?
5. Activated sludge digesters?
6. Oxidation ponds?
7. Ozonation?
8. Coagulation?
9. TOD?
10. Egg by products?

Section B

(Answer any **six** questions. Each question carries a weight of 2)

(6x2= 12 weights)

11. Discuss the scope of waste water treatment?
12. Explain the different types of waste?
13. Write a note on different types of insecticides and pesticides in waste waters?
14. List different byproducts obtained from fruits and vegetable waste?
15. Explain the by products from planation crops?
16. Explain in detail the secondary treatment of waste?
17. Explain briefly the process of chlorination and its importance in municipal waste water treatment?
18. Explain the microbiology of water and different testing methods?

Section C

(Answer any **two** questions. Each question carries a weight of 5)

(2× 5= 10 weights)

19. Discuss the characterization of waste?
20. Design a method used for industrial waste water treatment?
21. Describe the byproduct utilization in meat, egg, fish and poultry industries?
22. Explain the byproduct obtained from the waste in cereals, pulses and oilseeds?