SCHEME OF EXAMINATION

M.Sc. Food Technology

(As per Choice based Credit System w.e.f. the academic year 2016–2017)

Program Specific Outcomes

PSO1 The Master of Science in Food Technology will prepare the students to become a highly skilled professional in food technology, equipped with the necessary technical and managerial knowledge to successfully contribute to solving problems related to food industry, social issues like food security and food safety.

PSO2 The students would acquire in-depth knowledge of Food Technology with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge to contribute to the scientific and technological developments in food processing sector.

PSO3 A strong research aptitude will be established through one year of interdisciplinary research undertaken which will enable the students to opt for higher levels of learning and research in the specialized fields of Food Technology.

PSO4 Students will acquire a combination of theoretical, conceptual, analytical, and experimental knowledge and skills in the area of Food Science and Technology.

PSO5 The students shall have the ability to reproduce and apply the knowledge of Food Processing Technology, its fundamentals and specialization to the solution of complex Scientific & Technological problems in Food Technology.

PSO6 The students would acquire the ability to recognize the impact of knowledge and understanding of the Food Technology principles on the responsibilities relevant to the professional practices and apply the fundamental and specialized knowledge to own start ups or professional entrepreneurships.

PSO7 The students shall have the ability to identify, define and analyze problems and create processes and explore viable means to solve them competently using their scientific skills and technical knowhow to overcome the emerging issues and challenges in Food Processing Technology

PSO8 The students would be enabled to communicate with the technological community, and with society at large, regarding complex activities and issues related to food technology confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate food standards, make effective presentations, counsel and give instructions on food safety, health and nutrition issues and good food processing practices, food adulteration etc.

Credit Matrix for M.Sc. Food Technology Program (w.e.f. session 2016-17)

SEMESTER	CORE PAPER	ELECTIVE-(DISCIPLINE CENTRIC)	FOUNDATION COURSE	OPEN ELECTIVE (INTERDISCIPLINARY)	DISSERTATION	INDUSTRIAL TRAINING	TOTAL
I	28	-	-	-	-	-	28
II	20	04	02	03	-	-	29
III	12	12	-	03	-	02	29
IV	08	-	-		20	-	28
TOTAL	68	16	02	06	20	02	114

REQUIRED CREDITS FOR THE COURSE

CORE PAPER=72

SOFT CORE=12

OPEN ELECTIVE=06

FOUNDATION COURSE=02

DISSERTATION=20

INDUSTRIAL TRAINING=02

TOTAL=114

SCHEME OF EXAMINATION
M.SC. FOOD TECHNOLOGY (CHOICE BASED CREDIT SYSTEM)
(W.E.F. ACADEMIC SESSION 2016-17)

SEMESTER –I						
Paper No.	**Nomenclature of Paper**	**Credits**	**Hrs.**	**Max. Marks**	**Internal Assessment**	**Total Marks**
	CORE PAPERS					
16FTE21C1	Food Chemistry	4	4	80	20	100
16FTE21C2	Principles of Food Engineering	4	4	80	20	100
16FTE21C3	Basic Principles of Food Processing and Preservation	4	4	80	20	100
16FTE21C4	Food Microbiology	4	4	80	20	100
16FTE21C5	Food Analysis &Instrumentation	4	4	80	20	100
	LAB COURSES					
16FTE21CL1	Lab course-I (16FTE21C1, 16FTE21C2 & 16FTE21C5)	4	8	-	-	100
16FTE21CL2	Lab Course-II (16FTE21C3 & 16FTE21C4)	4	8	-	-	100
	TOTAL CREDITS = 28					700

Total Credits=28

Total Marks=700

SEMESTER –II						
Paper No.	**Nomenclature of Paper**	**Credits**	**Hrs.**	**Max. Marks**	**Internal Assessment**	**Total Marks**
	CORE PAPERS					
16FTE22C1	Technology of Cereals & Bakery Products	4	4	80	20	100
16FTE22C2	Technology of Fruits and Vegetables	4	4	80	20	100
16FTE22C3	Unit Operations in Food Engineering	4	4	80	20	100
	DISCIPLINE SPECIFIC (ELECTIVE)- I (Any one)					
16FTE22D1	Post Harvest Technology of Plantation Crops	4	4	80	20	100
16FTE22D2	Technology of Legumes and Oilseeds	4	4	80	20	100
16FTE22D3	Technology of Meat, Poultry and Fish Products	4	4	80	20	100
	OPEN ELECTIVE PAPER					
	To be opted by the students from the pool of open electives	3	3			
	FOUNDATION ELECTIVE					
	To be opted by the students from the pool of foundation electives	2	2			
	LAB COURSES					
16FTE22CL1	Lab Course-III (16FTE22C1, 16FTE22C2)	4	8	100	-	100
16FTE22CL2	Lab Course-IV (16FTE22C3 & 16FTE22D-1/2/3)	4	8	100	-	100
	TOTAL CREDITS= 29					

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SEMESTER –III

Paper No.	Nomenclature of Paper	Credits	Hrs.	Max. Marks	Internal Assessment	Total Marks
	CORE PAPER					
17FTE23C1	Technology of Milk and Milk products	4	4	80	20	100
17FTE23C2	Food Packaging	4	4	80	20	100
	DISCIPLINE SPECIFIC (ELE CTIVE)- I I (Any one)					
17FTE23DA1	Nutraceuticals and Functional Foods	4	4	80	20	100
17FTE23DA2	Food Additives	4	4	80	20	100
17FTE23DA3	Flavor Chemistry and Technology	4	4	80	20	100
	DISCIPLINE SPECIFIC (ELE CTIVE)- III (Any one)					
17FTE23DB1	Sensory Analysis of Foods	4	4	80	20	100
17FTE23DB2	Food Biotechnology	4	4	80	20	100
17FTE23DB3	Enzymes and Fermentation Technology	4	4	80	20	100
	OPEN ELECTIVE PAPER					
	To be opted by the students from the common pool	3	3			
17FTE23C3	Industrial Training**	2	-	50	-	50
	LAB COURSES					
17FT23CL	Lab Course-V (17FTE23C1 & 17FTE23C2	4	8	100	-	100
17FT23DL	Lab Course-VI (17FTE2DA1/DA2/DA3 & DB1/DB2/DB3	4	8	100	-	100
	Total credits = 29					

SEMESTER –IV

Paper No.	Nomenclature of Paper	Credits	Hrs.	Max. Marks	Internal Assessment	Total Marks
	CORE PAPERS					
17FTE24C1	Advances in Food Processing and Preservation	4	4	80	20	100
17FTE24C2	Food Safety and Quality Assurance	4	4	80	20	100
17FTE24C3	Dissertation/Project Work	20	40	-	-	300
	Total credits = 28					500

* **The students will have to undergo in plant training during the summer break after 2nd semester. However, the viva voce of the industrial training report will be conducted in the 3rd semester and hence the credits will be given to the students in the 3rd semester**

Instructions for the students

Course Types:

Hard Core (HC): There are Core Courses in every semester. These courses are to be compulsorily studied by a student as a core requirement to complete the requirement of a programme in a said discipline of study.

Soft Core Elective (SC): Soft core is a course which can be chosen from a pool of papers floated by the department. It will be supportive and discipline related & mandatory as per course curriculum.

Foundation/Supportive Course (FE): The foundation course is based upon the content that leads to Knowledge enhancement and is to be opted by the student from a pool of foundation course floated by the university. It is mandatory as per course curriculum.

Interdisciplinary Course/Open Elective (OE): Open elective course may be from an unrelated discipline. It is interdisciplinary/open elective & mandatory as per course curriculum and is to be opted by the students from a pool of open elective papers floated by various departments.

NOTE

1. For all lecture courses, one credit per lecture/week/semester will generally be adopted.
2. Each theory course will be of 4 hours and practical will be of 8 hours duration per week.
3. Each theory paper examination will be of 3 hours duration and practical examination will be of 4 hours duration.
4. The dissertation is to be innovative work based on small piece of research work allotted in 3rd semester. The allotment/distribution of students is to be done at department level. Scheme of chapters of dissertation may be as follows-

   Acknowledgement

   Certificate by Supervisor

   (i) Introduction with objectives
   (ii) Review of literature in brief
   (iii) Materials & methods
   (iv) Results
   (v) Discussion
   (vi) Summary

   Last date of submission will be 30th June without late fee. The evaluation of dissertation will be done by external examiner from a panel approved by PGBOS and an internal examiner. The written part of dissertation report shall account for 250 of marks and the viva-voce will be conducted by a duly constituted board of examiners for the remaining 50 marks.
5. The workload for dissertation work will be calculated as 1h/student/week.

SYLLABUS
Semester-1

Food Chemistry (16FTE21C1)

Course Outcomes:

CO1 Students would have acquainted with the chemical and functional properties of the major food constituents.
CO2 An understanding of the chemical and functional properties of various food constituents will be instrumental in optimizing the various food processing and preservation conditions.
CO3 An understanding of the chemistry of the various food constituents would make the students well acquainted with the principles of food analysis, preservation and processing.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I
Food chemistry- definition, scope and importance; water in food, water activity and shelf life of food; chemistry and stability of water and fat soluble vitamins; minerals and their bioavailability, Food enrichment and fortification.

Unit II
Carbohydrates -classification, physical and chemical properties of sugars, functional properties and uses of pectic substances, gums and dietary fiber in food; browning reaction in food: enzymatic and non-enzymatic browning, their occurrence and applications in food; starches: functionality of starch in foods, gelatinization and retro-gradation of starches, modified starches, resistant starches.

Unit III
Lipids classification, properties- lipolysis, auto-oxidation, rancidity and flavour reversion, thermal decomposition and effect of ionizing radiations; modification of fats and oils (hydrogenation and interesterification), fat mimetics.

Unit IV
Proteins : Classification and structures of protein and amino acids; physical, chemical and functional properties of proteins, functional properties of food proteins, modification of food protein in processing and storage and its implications, texturized, denaturation of protein, gel formation, functionality of egg proteins and wheat proteins in foods

Recommended Books:

1. Meyer, L.H.(1998) Food Chemistry, Van Nostrand, Reinhold Company Publication, New york, London.

2. Alias C. and Lindeu G (1991) Food Biochemistry, Ellis Horwood, New York
3. Pomeranz, Y and Meloon, R. (1995) Food Analysis: Theory and Practice, Westport, An AVI Publication, New York, Sydney, Toronto.
4. Fennema, R.O (1997) Food Chemistry, Second Edition, Food Science & Technology series, Marcel Dekker, INC., New York
5. John M. deMan (2007). Principals of Food Chemistry, Springer India pvt Ltd, New Delhi.
6. Tom Coultate (2016) Food The chemistry of its components, Published by Royal Society of Chemistry, Cambridge, UK

Principles of Food Engineering (16FTE21C2)

Course Outcomes:

CO1 An understanding of the basic principles of food engineering would enable the students to design and optimizes various process operations.
CO2 An understanding of the liquid transport and fluid flow principles would make the students capable of handling various types of fluid foods and their flow in food industry.
CO3 An understanding of the various heat transfer principles would help the students to design and optimize heat processing treatments regarding preservation of processing of any food material.
CO4 Knowledge of psychometric would enable the students to evaluate and optimize the food storage conditions in a food processing plants.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Introduction to food engineering; material and energy balances: basic principles, process flow diagrams, total mass balance, component mass balance, material balance problems involved in dilution, concentration and dehydration; heat balance calculations.

Unit II

Fluid flow principles: fluid statics and fluid dynamics, mass and energy balances in fluid flow; Newtonian and Non-Newtonian fluids, streamline and turbulent flow; fluid flow applications- measurement of pressure and velocity.
Liquid transport system- pipelines and pumps for food processing plants-positive displacement pumps, air-lift pumps, propeller pumps, centrifugal pumps and jet pumps.

Unit III

Heat transfer in food processing: modes of heat transfer- conductive, convective and radiative heat transfer; thermal properties of foods, conductive heat transfer in a rectangular slab, tubular pipe and multilayered systems, estimation of convective heat transfer coefficient, forced convection and free convection, estimation of overall heat transfer coefficient; heat exchangers: plate, tubular, scraped surface and steam infusion heat exchangers.
Thermal process calculations: commercially sterile concept, concept of D, F and Z values, reference F value; effect of temperature on thermal inactivation of micro-organisms, thermal process calculation for canned foods; calculation of processing time in continuous flow systems.

Unit IV

Psychrometrics: Properties of dry air: composition of air, specific heat of dry air, enthalpy of dry air and dry bulb temperature.
Properties of water-vapor: specific volume of water vapor, specific heat of water vapor, enthalpy of water vapor.

Properties of air-vapor mixtures: Gibbs-Dalton law, dew-point temp, humidity ratio (or moisture content), relative humidity, wet bulb temperature.

Psychrometric chart: use of psychrometric chart to evaluate complex air conditioning processes.

Recommended Books:

1. Singh, R.P and Heldman, D.R.(1984). *Introduction to Food Engg.,* Academic Press, INC, London.
2. Earle, R.L. (1983) *Unit Operations in Food processing*, 2nd Edition Pergamon Press Oxford,U.K.
3. Toledo, R.T.(1997). *Fundamentals of Food Process Engineering*, CBS Publishers, New Delhi.
4. Batty, J.C. and Folkman, S.L. 1983. *Food Engineering Fundamentals.* John wiley and Sons, New York.

Basic Principles of Food Processing and Preservation (16FTE21C3)

Course Outcomes:

CO1 Knowledge regarding heat processing and preservation of food would be helpful in designing, optimizing heat processing conditions for different types of foods in different conditions.
CO2 The students would be able to understand various low temperature preservation conditions and this technical knowhow would make them capable to select proper low temperature storage conditions for food materials.
CO3 Knowledge regarding drying and dehydration would make the students familiar with the processing of the dried foods and students can opt for their career in dried/dehydrated food products making food industries.
CO4 The students would be able to recommend suitable food preservatives for household methods for different types of food productions.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Scope and importance of food processing; historical developments in food processing; food spoilage: microbial, physical, chemical & miscellaneous.

Heat preservation and processing: heat resistance of microorganisms, thermal death curve, types of heat treatments and effects on foods, canning of foods, cans and container types, spoilage of canned foods, heat penetration, brief concept of different heat processing methods: blanching, roasting, frying, baking etc.

Unit II

Refrigeration storage: requirements of refrigeration storage, changes of foods during refrigeration storage, refrigeration load, chilling and refrigeration, cold storage.

Freezing and frozen storage: freezing curves, slow and quick freezing, factors determining freezing rate, freezing methods, changes in food during freezing, frozen food storage, freeze drying in food processing

Unit III

Dehydration: drying, dehydration and concentration, drying curves, drying methods and type of dryers; food concentration, methods of concentration of fruit juices, liquid food concentrates, changes in food during dehydration and concentration.

Water activity: role of water activity in food preservation, intermediate moisture foods (IMF), principles, characteristics, advantages and problems of IM foods.

Unit IV

Food frying: general principles, frying process; shallow frying and deep frying, frying oils, factors affecting oil uptake during frying.

Emulsification in food processing: principles, examples of emulsification in food; milk, ice-cream mix, coffee/tea whiteners, salad dressings, meat sausages, margarine and spreads.

Chemical preservation: types, uses and effects of class I and class II preservatives in foods.

House hold preservation methods: pickling, salt curing, oiling and smoking, sugar addition.

Recommended Books:

1. Norman, N.P and Joseph, H.H.(1997). Food Science, Fifth edition, CBS Publication, New Delhi
2. Frazier, W.C and Westhoff, D.C (1996). Food Microbiology, 4th edition, Tata Mc Graw Hill Publication, New Delhi.
3. Kalia M. and Sangita, S. (1996). Food Preservation and Processing, First edition, Kalyani Publishers, New Delhi.
4. Sivasankar, B. (2002): Food Processing and Preservation, Prentice Hall of India Pvt.Ltd., New Delhi.
5. Desrosier & Desrosier, Technology of Food Preservation.
6. Fellows, Food process technology: Principles and Technology, CRC publications. Khetarpaul N. (2005). Food Processing and Preservation, Dya Publishing House , New Delhi.

Food Microbiology (16FTE21C4)

Course Outcomes:

CO1 The students would become familiar with the different types of microorganisms, their sources and the factors affecting their growth in food products.

CO2 An understanding of the food born microbial diseases and food poisoning by microbes would make the students capable to increase awareness regarding public health.

CO3 An understanding of the detection of microorganisms by various techniques would be helpful to the students to detect microorganisms in food and their safe limit to ascertain the safety of different food products.

CO4 The students can pursue for the career in food microbial quality control enterprises.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Microbiology: Introduction, historical developments in food microbiology; prokaryotes and eukaryotes; classification of microorganisms- a brief account; sources of microorganisms in foods; microbial growth, growth curve; factors affecting growth-intrinsic and extrinsic factors controlling growth of microorganisms, microbiological criteria of foods and their significance.

Unit II

Effect of food preservatives, heating process, irradiation, low temperature storage, chemical preservatives and high-pressure processing on the microbiology of foods; control of water activity and microbial growth, applications of hurdle technology for controlling microbial growth.

Unit III

Foods microbiology and public health: food poisoning, types of food poisonings, important features etc; bacterial agents of food borne illness, food poisoning by clostridium, salmonella, E. coli, bacillus, staphylococcus etc.; non-bacterial agents of food borne illness: poisonous algae, and fungi - a brief account, the HACCP system and food safety used in controlling microbiological hazards.

Unit IV

Food spoilage and microbes of milk, meats, fish and various plant products, spoilage of canned foods; Indicators microorganisms, methods of isolation and detection of microorganisms or their products in food; conventional methods; rapid methods (newer techniques) - immunological methods; fluorescent, antibody, radio immunoassay, principles of ELISA, PCR (Polymerized chain reactions).

Recommended Books:

1. James M. Jay (2000). Modern Food Microbiology, 5th Edition, CBS Publishers.
2. Banwart, G.J. (1997). Basic Food Microbiology, CBS Publishers.
3. Adam M.R. & Moss, M.O. (1995). Food Microbiology, New Age International Pvt. Ltd Publishers.
4. Bibek Ray (1996). Fundamental Food Microbiology, CRC Press.
5. Stanier, R.Y. (1996). General Microbiology, Vth Edition, MacMillan

Food Analysis and Instrumentation (16FTE21C5)

Course Outcomes:

CO1 The knowledge regarding sampling techniques would make the students skilful for analytical work in food industry.

CO2 Analysis of various food components would make the students capable of analysing various food components and detection of food adulterants in foods.

CO3 The knowledge regarding the principles and applications of different analytical tools would prepare the students for analytical purpose and quality control labs in food industry.

CO4 The fundamental knowledge of various analytical techniques would be beneficial for the students pursuing for research and dealing with high and research equipments.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Introduction to food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results.

Unit II

Proximate analysis of foods: Principles of moisture, fat, protein, carbohydrates, crude fiber and vitamins in foods.

Unit III

Instrumentation in food analysis: principles, types and applications of colorimetry and spectroscopy, photometry, electrophoresis; chromatography and atomic absorption spectrophotometry.

Unit IV

Instrumentation in food analysis: color measurement in foods; X-ray analysis of foods and its applications; mass spectroscopy; nuclear magnetic resonance (NMR); differential scanning calorimetry (DSC).
Refractometry and ultrasonics in food analysis; texture analysis in foods, sensory versus instrumental analysis of texture, rapid methods of microbial analysis; immunoassays methods

Recommended Books:

1. Ronald S. Kirk, Ronald, Sawyer, (1991). *Pearson;s Composition & Analysis of foods*, 9th Edition Longman scientific & Technical , U.K.
2. Pomeranz , Y. & Mrloan (1978) . *Food Analysis: Theory and Practice, Westport,* connectiant : AVI .
3. Amerine, M.A. Pangborn, R.M., and Rosseler, E.B. 1965. Principles of Sensory Evaluation of Food. Academic Press, New York.

Lab Course-I (16FTE21CL1)

Course Outcomes:

CO1 Understanding of the food chemistry and its related phenomena/components through experimentation would be helpful in the understanding of the theoretical principles and applications of the food components and their chemistry.

CO2 In hand experimentation on engineering aspects of food processing and demonstration of various food engineering operations would strengthen the technical and engineering know-how of various food processing unit operations.

CO3 Knowledge of sample preparation, analysis and in hand applications of various instruments would provide a live demonstration of their working principles and their applications in the food industry.

Lab Course-II (16FTE21CL2)

Course Outcomes:

CO1 Students would be having in hand practical training on the basic principles of food processing and preservation like heating, refrigerating, canning, curing, pickling through processing and preservation of various food products.

CO2 Practical knowledge of the processing and preservation would be helpful in recommending safe and effective methods for food processing and preservation.

CO3 Students would be imparted with the in hand practical training on the microbial testing of the food products.

Semester 2nd

Technology of Cereals and Bakery Products (16FTE22C1)

Course Outcomes:

CO1 The knowledge of wheat and its technology would make the students to pursue their career in bread and biscuit industry, one of the largest sector of the food processing industry.

CO2 Knowledge of technology of rice and milling of rice-based products would make the students capable for rice industry as a rice technologist.

CO3 The students would be familiar with milling of corn and barley malting, which may help in seeking their career in sugar industry and distilleries.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Structure and chemical composition of wheat grain; criteria of wheat quality – physical and chemical factors; Wheat milling – general principles and operations, cleaning, conditioning and roller milling systems; flour extraction rates and various flour grades and types; criteria of flour quality, dough rheology and its measurement.

Unit II

Bread making processes, importance of critical unit operations in bread making, development in bread making methods: functions of ingredients/additives such as fact, emulsifiers, oxidants, reducing agents and conditioners: bread faults and staling: functionality of wheat proteins, carbohydrates, lipids and enzymes in bread making.
Technology of biscuit, cookies, crackers and cakes manufacturing: leavening agents in bakery products; baking powders as leavening agents in bakery products. Technology of noodles and pasta products.

Unit III

Structure and chemical composition of rice grain; milling of rice – types of rice mill; huller mill, sheller-cum-cone polisher mill; modern rice milling unit operation-dehusking, paddy separation, polishing and grading; factors affecting rice yield during milling; rice bran as rice milling byproducts.

Rice parboiling technology, different parboiling methods, CFTRI process of parboiling, changes during parboiling, advantages and disadvantages of parboiling.

Dimensional and cooking quality characteristics of rice and factors affecting cooking behaviour of rice grains; rice convenience foods: precooked rice, canned rice, expanded rice, rice-based infant food formulae.

Unit IV

Structure and composition of corn grain, different types of corn; wet and dry milling of corn, products of wet and dry milling of corn, corn starch and corn sweeterners (high fructose corn syrups) and their uses. Barley malting process: steeping, germination and drying; significance of malting; different types of malts and their food applications.

Recommended Books

1. Samuel, A.M.(1996) " *The Chemistry and Technology of Cereals as Food and Feed "*, CBS Publisher & Distribution, New Delhi.
2 Pomeranz, Y.(1998) *" Wheat : Chemistry and Technology"*, Vol 1,3" Am. Assoc. Cereal Chemists. St. Paul, MN, USA.
3 Honeney, R.C.(1986) *" Principles of Cereal Science and Technology"*, Am. Assoc. Cereal Chemists, St. Paul, MN, USA.
4. Pomeranz, Y. (1976*) " Advances in Cereal Science and Technology",* Am. Assoc. Cereal
Chemists St.Paul, MN, USA.
5. Juliano, B.O.(1685*). " Rice Chemistry and Technology",* Am. Assoc. Cereal Chemists,
St. Paul, MN,USA.
6. Chakraverty, A. 1988. *Postharvest Technology of Cereals, Pulses and oilseeds*. Oxford and IBH, New Delhi.
7. Kent, N.L. 1983. *Technology of Cereals.* 3rd Edn. Pergamon Press, Oxford, UK.

Technology of Fruits and Vegetables (16FTE22C2)

Course Outcomes:

CO1 The students would be acquainted with the post harvesting processing of the fruits and vegetables.
CO2 The knowledge of processing and technology of fruit-based products would facilitate the students to seek their career in the fruits and vegetables industry.
CO3 Students having familiarization with the utilization of fruits and vegetables wastes will be able to devise and design novel techniques in disposal of fruit industry wastes.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Classification and composition of fruits and vegetables and their nutritional significance; climacteric and no-climacteric fruits; post harvest treatments, edible coatings.
Physical and chemical indices of fruit maturity, crop maturity and ripening, bio-chemical changes during maturation, ripening, processing and storage.

Pre-processing operations: washing, blanching, peeling, sorting and grading of fruits and vegetables; minimal processing of fruits and vegetables; quality factors for processing, export standards, fruit product order (FPO).

Unit II

Technology of jam, jellies, marmalades, specifications, role of pectin and theories of gel formation.

Technology for juice pressing, juice extraction and clarification, methods of bottling, enzymatic clarification and debittering of juices, physiological and enzymological aspects of fruit juice production, fruit juice concentrates and powders- preparation and specifications, packaging.

Fruit juice beverages, squash, cordial, crush, RTS, nectar, syrups, blending of juices.

Unit III

Technology of tomato products: sauce, puree, ketchup and tomato paste

Fruit preserves and candied fruits, dehydrated fruits & vegetables, spoilage of processed products.
Canning of fruits and vegetables, preparation of syrups and brines, spoilage of canned fruits and vegetables

Unit IV
Stages of new product development, by products from fruit and vegetable wastes, utilization and disposal of fruit industry wastes.
Production of mushroom and its processed products;
Cashew and coconut: chemical composition, processing technology and their processed products.

Recommended Books:

1. R.P.Srivastava and Sanjeev Kumar (2001) : Fruit and Vegetable Preservation – Principles and Practices, Third edition, International Book distributing Co. Lucknow(India)
2. A.K.Thompson (2003): Fruit and Vegetables – Harvesting, handling and storage. 2nd edition Blackwell Publishing.
3. Er. B. Pantastico: Post harvest Physiology, handling and utilization of tropical and subtropical fruits and vegetables. AVI Publishing Company, Inc.
4. W.V Cruess (1997): Commerical Fruit and Vegetable Products. Allied Scientific Publishers. Bikaner (India)
5. Girdharilal (1996) Preservation of Fruits and Vegetables. ICAR, New Delhi
6. Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributin Co. Lucknow, India.

7. Hamson, L.P. 1975. Commercial Processing of Vegetables. Noyes Data Corporation, New Jersey.
8. Dauthy, M.E. 1997. Fruit and Vegetable Processing. International Book Distributing Co. Lucknow, India.

Unit Operations in Food Engineering (16FTE22C3)

Course Outcomes:

CO1 The students would be skilful enough to handle the various cleaning, sorting, grading, mixing, drying and freezing equipments to be used in food industry.
CO2 Students would be able to work on various food processing lines in food industry involving various unit operations in food engineering.
CO3 The students would be equipped with working acumen while handling various machines related to different food processing unit operations.
CO4 The students would be able to optimize the unit operations conditions while processing different food products.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Preliminary unit operations – material handling, cleaning, sorting and grading.

Material handling–theory, classification of various material handling equipments, conveyors and elevators

Cleaning – types of contaminants found on raw foods, aims of cleaning, methods of cleaning- dry, wet and combination methods; dry cleaning methods - screening, aspiration, magnetic cleaning and abrasive cleaning; wet cleaning methods- soaking, spray washing, flotation washing and ultrasonic washing.

Sorting and grading – advantages of sorting and grading, grading factors, methods of sorting and grading.

Unit II

Conversion unit operations – size reduction, mixing and filtration.

Size reduction- benefits of size reduction, nature of forces used in size reduction, criteria of size reduction, equipment selection (hardness of feed, mechanical structure of feed, moisture content and temperature sensitivity of feed); mode of operation of size reduction equipment – open circuit and closed circuit grinding, free crushing, choke feeding and wet milling; size

reduction of solid foods, fibrous foods and liquid foods; effects of size reduction on solid and liquid foods.

Mixing – mixing terminology (agitating, kneading, blending, and homogenizing), mixing equipments – mixers for liquids of low or moderate viscosity (Paddle agitators, turbine agitators and propeller agitators), mixers for high viscosity pastes (Pan mixer, horizontal mixer and dough mixer), mixers for dry solids (tumbler mixer & vertical screw mixer); effects of mixing on foods.

Filtration – filtration terminology (feed slurry, filtrate, filter medium, filter cake and filter), filtration methods/equipments – pressure filtration, vacuum filtration, & centrifugal filtration.

Unit III

Preservation unit operations **(**high temperature operations)- pasteurization, evaporation and dehydration.

Pasteurization– basic concept, effects of pasteurization on foods.
Evaporation – main functions of evaporation, factors affecting the rate of heat transfer, factors influencing the economics of evaporation, evaporation equipments –horizontal tube evaporators, vertical tube evaporator and plate evaporator; single and multiple effect evaporators.

Dehydration – objectives of dehydration, dehydration terminology, basic dehydration theory; drying curves, dehydration systems – tray drier, tunnel drier, drying time calculations.

Unit IV

Preservation unit operation **(**low temperature operations**)** - refrigeration, freezing and freeze drying.
Refrigeration – introduction, components of refrigeration systems – compressor, condenser and expansion valve; mechanical refrigeration system.

Freezing – technological principles of freezing operations, freezing systems- direct contact and indirect contact system; influence of freezing rate on food system; freezing time calculations.
Freeze drying – conventional drying vs freeze drying; equipments used and effects of freeze drying on food quality.

Recommended Books:

1. Earle, R.L. (1983) Unit Operations in Food Processing, 2nd Edition, Pergamon Press, Oxford, U.K.
2. Singh, R. P. and Heldman, D. R. (1984). Introduction to Food Engg., Academic Press, INC, London.
3. Harper, J.C. (1976) Elements of Food Engg., AVI Publ. Co., Westport, Connecticut.
4. Toledo, R.T. (1980). Fundamentals of Food Process Engg., AVI. Publ. Co., Westport, Connecticut.
5. Brennan, J.G., Buffers, J.R., Cowell N.D., Lilly, A.E.V. (1976). Food Engg. Operations, 2nd Ed., Elsevier, New York.
6. Lewis, M.J. (1987). Physical Properties of Foods & Foods Processing Systems, Ellis Horwood, England.

Post Harvest Technology of Plantation Crops (16FTE22D1)

Course Outcomes:

CO1 The students would be able to make their career in tea, coffee and spices manufacturing and processing sector.

CO2 The students would be able to provide the technical know-how regarding the analytical aspects, processing and quality control aspects of spices and their products.

CO3 The students would be able to learn processing and quality control of various plantation crops and they may start their own entrepreneurship in post harvest technology of plantation crops.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

UNIT -I

Coffee: Production, processing of coffee, drying, fermentation, roasting and brewing of coffee; decaffeinated coffee, coffee brew concentrate; types, standards and specifications of coffee products; chicory: technology of chicory powder and use in coffee products

UNIT -II

Tea: Production, composition and manufacturing; types of tea; tea products such as soluble tea, tea concentrate, instant tea, decaffeinated and flavored tea; quality evaluation and grading of tea.

UNIT -III

Cocoa: processing and analysis of cocoa beans; changes taking place during fermentation of cocoa bean; processing of cocoa products: cocoa powder, cocoa liquor manufacture, cocoa butter; chocolates: types and technology of chocolate manufacturing

UNIT -IV

Spices, condiments, seasonings and culinary herbs; classification and beneficial properties of spices; processing and manufacturing of major Indian spice: pepper, cardamom, ginger, chili and turmeric, clove, garlic, Cumin, coriander, cinnamon, mint and vanilla.
Oleoresins and essential oils: method of manufacture; chemistry of the volatiles; enzymatic synthesis of flavor identical; adulteration problem in spices, packaging of spices

Recommended Books

1. Kenneth T. Farrell (1985). Spices, condiments and seasonings. The AVI Pub. Company.
2. Banerjee B. 2002. *Tea Production and Processing*. Oxford Univ. Press.
3. Kenji Hirasa and Mitsno Takemasa(1998). Spice Science and Technology, Marcell Dekker, Inc.
4. Minifie BW. 1999. *Chocolate, Cocoa and Confectionery Technology*. 3rd ed. Aspen Publ.

5. NIIR. 2004. *Handbook on Spices*. National Institute of Industrial Research Board, Asia Pacific Business Press Inc.
6. Sivetz M & Foote HE. 1963. *Coffee Processing Technology*. AVI Publ.

Technology of Legumes and Oil Seeds (16FTE22D2)

Course Outcomes:

CO1 The students would be acquainted with knowledge of processing and milling technologies of legumes.
CO2 The students would be able to pursue their career in legume milling industry.
CO3 Knowledge of soybean processing would be helpful for the students to serve in food industries based on soya products and by-products.
CO4 The students would get opportunity to render their services in processing and quality control aspects of oil and oil products processing industries.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Status, production and major growing areas of legumes and oilseeds in India and world; structure and chemical composition of pulses and oilseeds; nutritional and antinutritional factors.

Milling scenario of pulses in India, milling techniques: dry milling and wet milling; processing of legumes: soaking, germination, decortication, cooking, fermentation; puffing, roasting and parching; utilization of pulses; protein isolates and concentrates; role of legumes in human nutrition.

Unit II

Processing and utilization of soyabean for value added products; soy based fermented products; innovative products from pulses and oilseeds; future developments in products and processes; products from legumes and uses: starch, flour, protein concentrates and isolates

Unit III

Sources of edible oils (groundnut, mustard, soyabean, sunflower, safflower, coconut, sesame and oil from other sources); physio-chemical properties; processing of oilseeds: rendering, pressing, solvent extraction, refining, hydrogenation; factors affecting extraction; packing and storage of fats and oils, changes during storage.

Unit IV

Oil specialty products: margarine, mayonnaise, salad dressing, fat substitutes etc; chemical adjuncts: lecithins and GMS; Nutritional food mixes from oilseeds: processing of oilseeds for food use, protein rich foods, protein enriched cereal food.

Recommended Books:

1. Hamilton, R.J. and Bharti, A. Ed. 1980. Fats and Oils: Chemistry and Technology. Applied Science, London.
2. Salunkhe, O.K. Chavan, J.K, Adsule, R.N. and Kadam, S.S. 1992. World Oilseeds: chemistry, Technology and Utilization. VNR, New York.
3. Wolf, I.A. Ed. 1983. Handbook of Processing and Utilization in Agriculture. (2 vol. set). CRC Press, Florida.
4. Mathews, R.H. Ed. 1989. Legumes: Chemistry, Technology and Human Nutrition. Marcel Dekker, New York.
5. Salunkhe, D.K., Kadam, S.S. Ed. 1989. Handbook of World Food Legumes: Chemistry, Processing and Utilization, (3 vol. set). CRC Press, Florida.

Technology of Meat, Poultry and Fish Products (16FTE22D3)

Course Outcomes:

CO1 The students would be able to understand physico-chemical properties of muscle and its conversion into meat.

CO2 Knowledge regarding cooking, preservation and quality control of meat and meat products would open the avenues for the students as meat technologist and quality control personnel in meat industry.

CO3 Knowledge of egg processing and preservation and poultry products would help the students to make their career in egg and poultry industry.

CO4 The students would be able to serve in marine products like fish and fish processing and preservation industry.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Status and scope of meat industry in India; Structure and physico-chemical properties of muscle

meat: composition and nutritive value, conversion of muscle into meat, post mortem changes in meat, rigor mortis, cold shortening, pre-rigor processing; stunning and slaughtering methods.

Aging of meat, meat tenderization- natural and artificial methods; cooking methods for meat: roasting, frying and braising; storage and preservation of meat: chilling, freezing, curing, smoking, dehydration, freeze-drying, irradiation, canning.

Unit II

Cooking, palatability and eating quality of meat, microbial spoilage of meat; restructured meat products (sausages), meat analogs; meat industry by products: importance and applications; intermediate moisture and dried meat products; meat plant hygiene and good manufacturing practices; packaging of meat products.

Unit III

Egg: Structure, composition and nutritive value of eggs, Storage and shelf life problems

Quality evaluation of eggs: international and external quality evaluation, candling, albumen index, Haugh unit, yolk index etc.

Egg preservation: grading of eggs, whole egg preservation, pasteurization, dehydration, freezing, egg products: egg powder, value added egg products (e.g., Meringues and Foams etc.), packaging of egg and egg products

Poultry products: types, chemical and nutritive value of poultry meat, slaughtering and evaluation of poultry carcasses; poultry cut-up parts and meat/bone ratio; preservation, grading and packaging of poultry meat.

Unit IV

Fish processing: factors affecting quality of fresh fish, fish dressing, chilling, freezing, glazing, salting and canning of fish; manufacturing of fish paste, fish oil, fish protein concentrate and fish meal; by-products of fish industry and their utilization.

Recommended Books:

1. Joshi, B. P. (1994). Meat Hygiene for Developing Country, Shree Almora Book Depot, India.
2. William J. & Owen J., (1977). Egg Science & Technology, AVI Publishing Company, INC. Westport, Connecticut.
3. Lawrie, R.A. (1998). Meat Science. Woodhead Publishers.
4. Mead, G. (2004). Poultry Meat Processing and Quality. Woodhead Publishers.
5. Panda, P.C. (1992). Text Book on Egg and Poultry Technology, Vikas Publishers
6. William J. & Owen J. (1977). Egg Science & Technology, AVI Publishing Company INC. Westport, Connecticut.

Lab Course-III (16FTE22CL1)

Course Outcomes:

CO1 Students would be acquainted with the processing and quality analysis of cereals and cereal based products like bakery products.

CO2 Theoretical concepts of fruits and food processing and preservation would be strengthened through practical training on the development and preservation of fruits and vegetable based products.

CO3 Development of value added novel food products based upon cereals and fruits and their waste material through laboratory experimentation would be helpful in

recommending and guiding food industry for the novel value added food products development.

Lab Course-IV (16FTE22CL2)

Course Outcomes:

CO1 Demonstration and working experience with the various engineering unit operations would be helpful in clarification and understanding of the theoretical working principles, applications and importance of the various engineering unit operations in food processing.
CO2 Students would be acquainted with the experimental to assess the quality of the plantation crops like tea and coffee.
CO3 Theoretical concepts in oilseed processing and meat and egg processing would be strengthened through practical exposure of the students while conducting experiments on the quality analysis of oilseeds, eggs or meat products.

Semester 3rd

Technology of Milk and Milk Products (17FTE23C1)

Course Outcomes:

CO1 The students would be able to analyze adulteration problems in milk.
CO2 The students would find jobs as dairy technologists in liquid milk processing and milk based processed food industries.
CO3 The students would be able to optimize and refine the processing technology for indigenous milk products and novel dairy products.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Dairy industry in India: scope, strengths and opportunities for dairy industry

Milk: definition, composition and nutritive value; factors affecting composition of milk

Physico-chemical properties of milk : chemical properties of milk lipids, milk fat structure, fat destabilization; functional properties of milk lipids, milk proteins, their types, precipitation (casein micellar structure and its aggregation); milk enzymes, milk coagulation; lactose; vitamins and minerals in milk.

Technology of fluid milk: filtration/clarification, standardization, pasteurization (LTLT, HTST),
sterilization, homogenization, UHT processing, aseptic packaging, storage and distribution

Unit II

Technology of recombined and reconstituted milk: composition, process of manufacture, defects

Technology of condensed and evaporated milk: composition, process of manufacture, defects (their causes and prevention).

Technology of milk powders (WMP, SMP): composition, process of manufacture, defects (their causes and prevention), instantization of milk powder.

Technology of Cheese: classification, composition, Nutritive value, process of manufacture of cheddar, mozzarella, cottage and processed cheese, defects (their causes and prevention).

Unit III

Technology of yogurt, Acidophilus milk, bulgaricus milk, kumiss and kefir.

Technology of frozen milk products: composition, process of manufacture, defects (their causes and prevention).

Technology of indigenous milk products: dahi, butter, ghee, channa, paneer, khoa etc.

Newer concepts in dairy products: cream powder, sterilized cream, butter spread, butter powder, cheese spread, whey protein concentrates, Lactose

Unit IV

Membrane processing of milk: types of membranes, applications of reverse osmosis, ultrafilteration and microfiltration in dairy industry

Utilization of milk industry by-products: Importance / Need and food applications

Milk and milk product standards and legislations in India: Grading of milk and criterion of grading, milk adulteration problem, synthetic milk

Dairy plant sanitation: hygiene in dairy Industry, different types of cleansing and sanitizing agents, their applications, cleaning systems

Recommended Books:

1. Sukumar, De (1994). Outlines of Dairy Technology. Oxford University Press.
2. Smith G. (2003). Dairy processing improving quality. Woodhead Publishers.
3. Andrews, A.T. (1994). Biochemistry of Milk Products. Woodhead Publishers.
4. Technology of Dairy Products by Early, R.
5. Aneja RP, Mathur BN, Chandan RC & Banerjee AK. 2002. *Technology of Indian Milk Products*. Dairy India Publ.

6. Rathore NS *et al.* 2008. Fundamentals of Dairy Technology - Theory & Practices. Himanshu Publ.
7. Walstra P. (Ed.). 2006. Dairy Science and Technology. 2nd Ed. Taylor & Francis.

Food Packaging (17FTE23C2)

Course Outcomes:

CO1 The students would be able to explain the requirement of packaging material and its characteristics for packaging of different types of food materials.
CO2 The students would become familiar with various novel packaging techniques and can provide their technical skills in the food package manufacturing industry.
CO3 Knowledge of modified atmosphere packaging would make the students acquainted with the scientific and technical know-how for the modified atmosphere packaging conditions for different types of food materials.
CO4 The students would be able to serve in food industries, which deal in packaging of different types of food materials.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Introduction to Food Packaging: definition, factors involved in the evolution and selection of a food package, functions of food packaging (containment, protection, convenience and communication).

Paper and paper based packaging materials: types of paper (Kraft, bleached, greaseproof, glassine), paper products (paper bags, cartons, drums and molded paper containers), functional properties of paper; testing of paper packaging materials.

Safety considerations in food packaging – types of food safety problems associated with package, package labeling and food safety.

Unit II

Plastic packaging materials: classification of polymers, functional and mechanical properties of thermoplastic polymers; processing and converting of thermoplastic polymers (extrusion, blow molding, injection molding, compression molding, lamination and heat sealing); testing of plastic packages.

Packaging requirements of selected foods- cereal and snack food, beverages, milk and dairy products, poultry & eggs, red meat, frozen foods, horticultural products and microwavable foods.

Unit III

Metal packaging materials: container making processes (end manufacture, three-piece can manufacture and protective and decorative coatings); functional properties of metal containers; Tin plate containers- quality control tests.

Glass packaging materials: composition and manufacture of glass containers; glass container nomenclature; glass containers-closure functions, closure terminology and construction; properties of glass containers – mechanical, thermal and optical properties; testing of glass containers.

Unit IV

Aseptic packaging of foods: sterilization of packaging material food contact surfaces & aseptic packaging systems; active food packaging – definition, scope, physical and chemical principles involved.

Edible films and coatings– use of edible active layers to control water vapor transfer, gas exchange, modification of surface conditions with edible active layers.

Oxygen absorbents – classification and main types of oxygen absorbents, factors influencing the choice of oxygen absorbents, factors influencing the choice of oxygen absorbents, application of oxygen absorbents for shelf-life extension of food and advantages and disadvantages of oxygen absorbents.

Ethanol vapor: ethanol vapour generator, uses of ethicap for shelf-life extension of food, effect of ethanol vapour on food spoilage/food poisoning bacteria, and advantages and disadvantages of ethanol/vapour generators.

Recommended Books:

1. Robertson, G.L.(2006). Food Packaging: Principles and Practice (2nd ed.), Taylor & Francis
2. Sacharow, S. and Griffin, R.C. (1980) Principles of Foods Packaging, 2nd Ed., Avi,Publication Co. Westport, Connecticut, USA.
3. Athalye, A.S. (1992), Plastics in Packaging, Tata McGraw –Hill Publishing Co., New Delhi.
4. Rooney, M.L. (1995). Active Food Packaging, Blackie Academic & Professional, Glasgow,UK.
5. Bakker, M. (1986) The Wiley Encyclopaedia of Packaging Technology, John Willey & Sons. Inc; New York.
6. Food Packaging Technology Handbook. NIIR Board, National Institute of Industrial Research, 2003
7. Ahvenainen, R. (Ed.) Novel Food Packaging Techniques, CRC Press, 2003
8. Han, J.H. (Ed.) Innovations in Food Packaging, Elsevier Academic Press, 2005
9. Coles, R., McDowell, D. and Kirwan, M.J. (Eds.) Food Packaging Technology, CRC Press, 2003

Nutraceutical and Functional Foods (17FTE23DA1)

Course Outcomes:

CO1 The students would be able to explore possibilities of developing functional foods by incorporating various functional food components.

CO2 The students would be able to advise and counsel regarding the role of different functional foods in disease prevention and community health issues like diabetes, cardiac, obesity etc.

CO3 The students would be able to find jobs in R&D in the food and drug industries related with isolation and utilization of various nutraceutical compounds for functional food formation.

CO4 The students would be able to pursue their career in R&D related to novel food product development.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Concept on Nutraceuticals: nutraceutical and functional foods, nutraceutical as new dietary ingredients, biological significance of nutraceuticals, nutraceuticals and dietary supplement, world market for nutraceuticals, regulatory issues

Nutrigenomics: nutrigenomics an introduction and its relation to nutraceuticals.

Unit II

The role of nutraceuticals/functional foods in disease prevention: angiogenesis and cardiovascular diseases, cancer, diabetes, cholesterol management, obesity and inflammation dosage levels,

Unit III

Health benefits of nutraceuticals, natural pigments (chlorophyll, chlorophyllin, carotenoids) anthocyanins, glucosinolates, isoflavonoids, phytoestrogens, omega-3 and omega-6 fatty acids, antioxidants, phytosterols; dosage for effective control of disease or health benefit with adequate safety

Unit IV

Definition, development of functional foods, isolation, storage, processing and stability of phyochemicals/bioactive compounds.
Prebiotics and probiotics: usefulness of probiotics and prebiotics in gastro intestinal health and other benefits, beneficial microbes; prebiotic ingredients in foods; types of prebiotics and their effects on gut microbes, resistant starch, fructo-oligosaccharides as probiotic food components

Recommended Books:

1. Brigelius-Flohé, J & Joost HG. (2006). Nutritional Genomics: Impact on Health and Disease. Wiley VCH.
2. Cupp J & Tracy TS. (2003). Dietary Supplements: Toxicology and Clinical Pharmacology. Humana Press.
3. Gibson GR & William CM. (2000). Functional Foods - Concept to Products.

4. Goldberg I. (1994). Functional Foods: Designer Foods, Pharma Foods.
5. Losso JN. (2007). Angi-angiogenic Functional and Medicinal Foods. CRC Press
6. Neeser JR & German BJ. (2004). Bioprocesses and Biotechnology for Nutraceuticals.Chapman & Hall.
7. Robert EC. (2006). Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.
8. Shi J. (2006). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC Press.
9. Webb GP. (2006). Dietary Supplements and Functional Foods. Blackwell Publ.

Food Additives (17FTE23DA2)

Course Outcomes:

CO1 The students would be able to explain the properties and applications of food additives in food products.
CO2 Knowledge of colouring and flavouring agents would make the students able to detect the food adulteration problems in foods.
CO3 The students would be able to pursue their career in various food colours, flavours, sweeteners and other food additives making food industries.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Food additives- definitions, classification and functions, need for food additives, food preservatives, classifications, antimicrobial agents (types, mode of action and their application), safety concerns, regulatory issues in India, international legal issues

Nutrient supplements & thickeners, polysaccharides, bulking agents, antifoaming agents, synergists, antagonists.

Unit II

Antioxidants (synthetic and natural, mechanism of oxidation inhibition), chelating agents: types, uses and mode of action

Coloring agents: color retention agents, applications and levels of use, natural colorants, sources of natural color (plant, microbial, animal and insects), misbranded colors, color extraction techniques, color stabilization

Unit III

Flavoring agents: flavors (natural and synthetic flavors), flavor enhancers, flavor stabilization, flavor encapsulation

Flour improvers: leavening agents, humectants and sequesterants, hydrocolloids, acidulants, pH control agents buffering salts, anticaking agents, etc.

Unit IV

Sweeteners: natural and artificial sweeteners, nutritive and non-nutritive sweeteners, properties and uses of saccharin, acesulfame-K, aspartame, corn sweeteners, invert sugar sucrose and sugar alcohols (polyols) as sweeteners in food products

Emulsifiers: Types, selection of emulsifiers, emulsion stability, functions and mechanism of action.

Additives, food uses and functions in formulations; permitted dosages

Recommended Books:

1. Branen AL, Davidson PM & Salminen S. (2001). Food Additives. 2nd Ed. Marcel Dekker.
2. Gerorge AB. (1996). Encyclopedia of Food and Color Additives. Vol. III. CRC Press.
3. Gerorge AB. (2004). Fenaroli's Handbook of Flavor Ingredients. 5th Ed. CRC Press.
4. Madhavi DL, Deshpande SS & Salunkhe DK. (1996). Food Antioxidants: Technological, Toxicological and Health Perspective. Marcel Dekker.
5. Morton ID & Macleod AJ .(1990). Food Flavours. Part A, B & C. Elsevier.
6. Nakai S & Modler 6. HW. (2000). Food Proteins: Processing Applications. Wiley VCH.
7. Stephen AM. (2006). Food Polysaccharides and Their Applications. Marcel Dekker.

Flavour Chemistry and Technology (17FTE23DA3)

Course Outcomes:

CO1 The knowledge of flavour chemistry and technology would empower the students to get expertise in sensory analysis labs regarding flavour of foods.
CO2 The students would be able to understand the flavour characteristics of food products under processing conditions.
CO3 The students would become familiar with various food processing operations and conditions for the production of various flavours and flavouring compounds.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit 1

Definition and description of flavor, flavor profile and its principal chemical constituents. Sensation of flavor vs taste odor/smell, and mouth feel, influence of chemical constituents on flavor and their interaction with flavor characteristics, flavor emulsions

Unit 2

Natural and synthetic flavoring substances and their chemical characteristics. Flavor components / constituents of fruit and vegetables, coffee, tea and cocoa bean, spices and condiments.

Unit 3

Extraction techniques/methods of flavoring compounds from different sources, their utilization and applications. Analysis of flavors components (subjective and objective).

Unit 4

Production of flavouring compounds during food processing (Lipid oxidation, maillard reaction etc.) Biological routs for the production of flavours, enzymes and microbial production of flavouring compounds

Recommended books

1. Burdock GA. 2004. Fenaroli's Handbook of Flavor Ingredients.5th Ed.CRC Press.
2. Deibler D & Delwiche J. 2004. Handbook of Flavor, Characterization: Sensory Analysis, Chemistry and Physiology. Marcel Dekker.
3. Heath HB.1986. Flavor Chemistry and Technology.CBS Publ. New Delhi.
4. Taylor A. 2002. Food Flavor Technology. Sheffield Academic Press.

Sensory Analysis of Foods (17FTE23DB1)

Course Outcomes:

CO1 The sound knowledge of sensory evaluation would enable the students to perform sensory analysis of foods as a sensory expert.
CO2 The students would be able to select and perform different types of sensory tests depending upon the conditions and food materials.
CO3 The students would be able to pursue their career in the sensory quality evaluation food labs in various industries and other analytical labs.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

UNIT I

Definition of sensory evaluation, Importance of sensory evaluation, general testing conditions i.e.Testing area, testing setup, Lighting setup, Testing schedule; Preparation of Samples: Coding and order of presentation, Types of panels-trained and consumer panels, Evaluation card preparation.

UNIT II

Selection of sensory panellists; Factors influencing sensory measurements; Sensory quality parameters -Size and shape, texture, flavour, aroma, taste, colour, temperature sensation

UNIT III

Sensory testing of foods: Threshold tests, Difference tests, Ranking tests, Hedonic tests, Acceptance and preference tests, Scoring test, Sensitivity tests

UNIT IV

Methods of sensory evaluation of different food products: milk and milk products, fruit and vegetables, cereal products, confectioneries and chocolates, coffee and tea, spices

Suggested Readings

1. Amerine MA, Pangborn RM & Rossles EB. 1965. *Principles of Sensory Evaluation of Food.* Academic Press
2. Jellinek G. 1985. *Sensory Evaluation of Food - Theory and Practice*. Ellis Horwoood.
3. Lawless HT & Klein BP. 1991. *Sensory Science Theory and Applicatons in Foods*. Marcel Dekker.
4. Maslowitz H. 2000. *Applied Sensory Analysis of Foods*. Vols. I, II. CRC Press
5. Piggot JR. 1984. *Sensory Evaluation of Foods*. Elbview Applied Science Publ.
6. Potter NN & Hotchleiss JH. 1997. *Food Science*. 5th ed. CBS
7. Rai SC & Bhatia VK. 1988. *Sensory Evaluation of Agricultural Products.* Indian Agricultural Statistics Research Institute (ICAR).
8. Stone H & Sidel JL. 1985. *Sensory Evaluation Practices*. Academic Press
9. Watts CM, Ylimaki CL, Jaffery LE & Elias LG.1989. *Basic Sensory Methods for Food Evaluation*. Int. Dev. Res. Centre, Canada.

Food Bio-technology (17FTE23DB2)

Course Outcomes:

CO1 The students would be able to explain and apply bio-technological techniques for the improvement of food and food products.

CO2 The knowledge of food bio-technology would empower the students to render their scientific skills in their genetic engineering and protein engineering for the production of food products, bio-preservatives and other useful bio components.

CO3 The students would be able to find jobs in the industries based on bio-tech foods.
CO4 The students would have option to pursue their research career in emerging areas of food biotechnology.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Introduction to food biotechnology; basic principles of genetic engineering; improvement of the food crops by genetic engineering; genetically modified plants and animals for enhanced food production; safety of GM food crops.

Unit II

Natural antimicrobials for food preservation: phytoalexins, essential oils and their components; bacteriocins: nisin, pediocins etc; applications of bacetriocins in food systems as biopreservatives

Unit III

Protein engineering in food technology: methods, applications of protein engineering to produce glucose isomerase, Lactobacillus beta-galactosidase.

Biotechnological routes to food flavour production: microbial, enzymatic

etc. **Unit IV**

Biotechnology and Food ingredients: fat substitutes, biocolors and sweeteners.
Transgenic plant foods: golden rice, Bt brinjal, maize, tomato, potato, soyabean etc. Intellectual property rights (IPR) issues and biopiracy problems; effect of biotech foods on the food business of developing and developed countries

Recommended Books:

1. Lee, B.H. (1996). Fundamentals of Food Biotechnology, VCH Publishers.
2. Tombs, M.P. (1991). Biotechnology in Food Industry, Open University Press, Milton Keyness.
3. Knorr, D. (1987). Food Biotechnology, Marcel Dekker , INC , new yark.
4. Schwartzberg, A & Rao (1990). Biotechnology & Food Process Engineering, Marcel Dekker , INC , New York.
5. Goldberg, I & Williams, R. (1991). Biotechnology and food Ingredients, Van Nostrand Reinhold, New York.
6. King , R . D. and Cheetham , P.S.J. (1986)). Food Biotechnology, Elsevier Applied Science, London.

Enzymes and Fermentation Technology (17FTE23DB3)

Course Outcomes:

CO1 The students would be able to know about the enzymes and their applications in processed foods.
CO2 The knowledge regarding fermentation and fermentors would enable the students to pursue their career in fermented foods making industries especially breweries.
CO3 Knowledge of processing and production of fermented foods would enable the students to start their own entrepreneurship based on production of fermented indigenous foods and other food products.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Enzymes– classification, properties, characterization,

Enzymes for starch modification (maltodextrins and corn syrup solids: liquefaction, saccharification, dextrinization, isomerization for production of high-fructose-corn-syrup,fructose and fructo-oligosaccharides). Enzymes for protein modification (hydrolysates and

bioactive peptides), Enzymes for Lipid modification.

Unit II

Role of enzymes in Dairy processing (cheese making and whey processing), role of enzymes in meat processing (tenderization) and egg processing, enzymes for the fruit juice clarification and debittering, role of enzymes in brewing**,** baking (fungal -amylase for bread making; maltogenic -amylases for anti-staling; xylanases and pentosanases as dough conditioners; lipases or dough conditioners

Unit III

Introduction to fermentation, batch and continuous, solid state/submerged fermentations, fermenter types and design, Downstream processing in fermentation: objectives, various product recovery and purification methods.

Unit IV

Fermentation reaction and process for the production of fermented foods like soya sauce, natto, sauerkraut, yoghurt, cheese, alcoholic beverages like beer and wine. Fermentative production of polysaccharides like dextran and xanthan.

Recommended books

1. Whitehurst,R.J. & Van-Oort,M., (2010), Enzymes in Food technology, Second edition Blackwell Publishing Ltd
2. Aehle, W. (2007) Enzymes in Industry: Production and application. Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim
3. Rastall,R (2007) Novel enzyme technology for food applications Woodhead Publishing Limited, Abington Hall, Abington, Cambridge CB21 6AH, England
4. Kalaichelvan, P.T., (2002), Bio process technology, MJP publishers, Chennai
5. Joshi, V.K. and Ashok Pandey, 1999, Biotechnology: Food Fermentation, Microbiology, Biochemistry and Technology , Vol. I & vol. II Educational Publisher.
6. Peppler, H.J. and D. Perlman, 2004, Microbial Technology : Fermentation Technology , 2nd Edition, Vol. II Academic Press / Elsevier.

Lab Course-V (17FT23CL)

Course Outcomes:

CO1 The students will be acquainted with the hands on practical training for analysing liquid milk samples for their various constituents and adulterants.

CO2 Students will become familiar with the use and properties of various types of packaging films used for different types of food products.

CO3 Demonstration of canning and bottling operations will make the students skilful for working on canning and bottling units.

CO4 Development and quality evaluation of milk based products will provide hands on practical training for the students.

Lab Course-VI (17FT23DL)

Course Outcomes:

CO1 Experimentation, identification and analysis of various types of food additives will make the students skilful for quality testing of the various types of food products.

CO2 The experiments on flavour analysis and sensory analysis will train the students to act as professional sensory analyst in food labs.

CO3 The experimentation on functional foods and fermentation based products will increase the exposure and professional training of the students for the novel processed food product development.

Industrial Training (17FTE23C3)

Course Outcomes:

CO1 Practical exposure of the students to the various techniques, processes and practices in a food processing industry.

CO2 Strengthening of the theoretical concepts and principles through in hand practical training and working with the various scientific instruments.

CO3 Development of professional aptitude and managerial skills while working in a food industry/institute.

CO4 The students will get an opportunity to prove his/her worth as a food techologist paving the way for their career and placement in a food industry.

Semester 4th

Advances in Food Processing and Preservation (17FTE24C1)

Course Outcomes:

CO1 The students would become acquainted with the advanced and novel food processing and preservation techniques.

CO2 The knowledge of extrusion technology and hurdle technology would enable the students to pursue their career in extruded foods and minimally processed foods making industries.

CO3 The students would become familiar with the novel techniques like ultrasounds in food processing, super critical fluid extraction, high pressure technology and membrane technology, which will benefit them to pursue their research career related to these technologies.

CO4 The knowledge of advance techniques in food processing preservation would help the students to develop novel food products with improved quality characteristics.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Extrusion technology: general principles, extrusion process, advantages of extrusion, extrusion equipment, single screw extruders and twin screw extruders, effect of extrusion on food properties, extrusion of starch based foods.

Hydrostatic pressure technology: general principles, effect of hydrostatic pressure on microorganisms-possible mode of action, application of hydrostatic pressure technology in food industry.

Unit II

Hurdle technology: principles and basic aspects of hurdle technology, different hurdles, hurdle effect, application of hurdle technology in dairy products, intermediate moisture foods, fermented products, heated foods and chilled foods.

Membrane technology: introduction of membrane, their classification and function, principles of reverse osmosis and ultrafiltration, nanofilteration and microfilteration, applications of membranes in food processing industry, modules for using membrane filters.

Unit III

High intensity electric field pulses (HIEFP): principles, generation of electric field pulses, applications in foods, effect on bread making and wheat dough and bread making properties, effect of HIEFP on microorganisms.

Ultrasound in food processing and preservation: Introduction, ultrasound instrumentation, ultrasound processing for enhancement of mass transfer, heat transfer and homogenization and emulsification.

Unit IV

Priciples and uses of ohmic heating, dielectric heating and infra red heating

Microwaves processing, properties of microwaves, mechanism of heating, application of microwave in food processing and its effects on nutrients.

Super critical fluid extraction, antifreeze proteins in food preservation
Food irradiation, use of ionization radiations in food preservation, sources, units, effects, limitations, dose determination, safety and wholesomeness of irradiated foods, food irradiation techniques and recent applications of irradiation in food preservation.

Recommended Books:

1. Gloud, G. W. (1995). New Methods of Food Preservation, Springer Publication
2. Holdswarth, S. D. (1993). Aseptic Processing and Packaging of Food Products, Elsevier, London.
3. Church, P. N. (1993). Principles and Applications of Modified Atmosphere Packaging of Food, Blackie Academic & Professional, U.K.
4. Leistner L & Gould G.W. (2002). Hurdle Technologies: Combination Treatments for Food Stability, Safety and Quality. Springer Publications
5. Gustavo V. Barbosa-Cánovas, María S. Tapia, M. Pilar Cano (2005). Novel Food Processing Technologies , CRC press
6. Tewari, G, Juneja, V.K. (2007). Advances in thermal and non-thermal preservation, Wiley Blackwell Press
7. Da Wen Sun (2005). Emerging Technologies for Food Processing, Academic Press

Food Safety and Quality Assurance (17FTE24C2)

Course Outcomes:

CO1 The knowledge of food safety and food adulteration issues would empower the students to counsel and detect for the various adulterations and safety threats in food and food products.

CO2 The students would be enabled to develop food quality and safety management systems in food industries.

CO3 The students would be able to pursue their career in food quality control labs in various food industries and other related organizations.

CO4 The knowledge regarding various standards and regulatory provisions would be beneficial for the students while pursuing their own entrepreneurship in food processing sector or while finding jobs in standard making organizations.

Detailed Syllabus Contents:

There will be nine questions in all. The first question comprising of short answer type questions covering the entire syllabus will be compulsory. The remaining eight questions will comprise of a set of two questions from each unit and the candidate will be required to attempt four questions selecting at least one from each unit. All questions carry equal marks.

MM: 80
Time: 3h

Unit I

Introduction to concepts of food quality, food safety, food quality assurance and food quality management; objectives, importance and functions of quality control, Current challenges to food safety

Food adulteration, nature of adulterants, methods of evaluation of food adulterants and toxic constituents.

Unit II

Principles of food quality assurance, total quality management (TQM) – good manufacturing/management practices, good hygienic practices, good lab practices, general awareness and role of management practices in quality control

Food safety management, applications of HACCP in food safety, concept of food traceability for food safety,

Unit III

Microbial quality control: determination of microorganisms in foods by cultural, microscopic, physical, chemical methods.

Statistical quality control in food industry

Unit IV

Role of national and international regulatory agencies, Bureau of Indian Standards (BIS), AGMARK, Food Safety and Standards Authority of India (FSSAI), Introduction to WTO agreements: SPS and TBT agreements, Codex alimentarious commission, USFDA, International organization for standards (ISO) and its standards for food quality and safety (ISO 9000 series, ISO 22000, ISO 15161, ISO 14000)

Recommended Books:

1. Early. R. (1995): Guide to Quality Management Systems for the Food Industry, Blackie, Academic and professional, London.
2. Gould, W.A and Gould, R.W. (1998). Total Quality Assurance for the Food Industries, CTI Publications Inc. Baltimore.
3. Pomeraz, Y. and MeLoari, C.E. (1996): Food Analysis: Theory and Practice, CBS publishers and Distributor, New Delhi.

Dissertation/Project Work (17FTE24C3)

Course Outcomes:

CO1 Development of research orientation and aptitude in the students enabling them to pursue for higher research studies.

CO2 Hands on practical training on using various instruments and other statistical tools will enhance the knowledge and technical experience of the students.

CO3 Enhancement of logical reasoning, analytical power and independent thinking to hypothesise to research problem and find its solutions.

CO4 Report writing, presentation and publication of results will provide platform to be interactive with the scientific community.