



Proposal for

Ph.D. Degree Programme in Food Technology

at

College of Food Technology

VNMKV, Parbhani

Vasantrao Naik Marathwada
Krishi Vidyapeeth,
Parbhani

2012-13

VASANTRAO NAIK MARATHWADA KRISHI VIDYAPEETH, PARBHANI

Proposal for Ph.D. Degree Programme in Food Technology at College of Food
Technology, VNMKV, Parbhani

1)	Title of the Proposal	:	Ph.D. Degree Programme in Food Technology at College of Food Technology, VNMKV, Parbhani
2)	Departments in the Institute	:	Department of Food Science and Technology Department of Food Engineering Department of Food Chemistry and Nutrition Department of Food and Industrial Microbiology Department of Food Trade and Business Management
3)	Mandate	:	Teaching, Research and Extension Education in Food Science and Technology
4)	Place of the Implementation	:	College of Food Technology, Vasantryao Naik, Marathwada Krishi Vidyapeeth, Parbhani
5)	Starting Year	:	2012-13 (Proposed)

INTRODUCTION

The College of Food Technology was sanctioned by the Government of Maharashtra in 1975 and the full fledged College of Food Technology was established in 1976 as one of the constituent colleges of this University to fulfill the academic and practical aspirations of the people of Maharashtra. It is one of the unique and premier institutions in the country, particularly concerns of the overall developments in technology, research and extension in the vital and useful field of food science and technology. This faculty offers B. Tech Degree programme of 4 years duration including Experiential Learning and In-plant Training of 4 months in faculty Pilot plant/Experiential Learning Programme Centre and food and allied industries and 2 years M. Tech Degree programme. This faculty helps in perspective planning of farm level and industrial applicable post-harvest technology of food crops during the post green revolution era in the country. A holistic endeavor is to provide food security and nutritional security to forthcoming generation. Human resource development in food science and technology is the major goal of the faculty. The technological monitorization of post harvest operations and modernization of existing agro-processing infrastructure coupled with installation of need base highly sophisticated food industries based on appropriate technology play a

vital role in national economy in general and rural economy in particular. This Holistic approach as fundamental need of 21st century has been accepted as an innovative challenge through the strategic and perspective research plan of the faculty. Socioeconomic aspects of post harvest management systems of diversified food crops, their practical and environmental implications have also been taken care through research and extension monitoring programs of the faculty.

Indeed agricultural continues to occupy the prominent and vital position in the national economy and hence the main mandate of this college is to evolve an innovative education strategy aimed at developing an agrarian self-sufficient human community in the country.

PROGRAMME OBJECTIVE

The objective of the Ph.D. programme is to cater the need of highly qualified human resources in the field of Food Science and Technology that can identify and solve problems related to food processing and development of safe, nutritious and health promoting food. This will also provide academia, government and industry with highly qualified food scientists who shoulder the responsibilities for the infrastructure which allows for efficient production, marketing, safety and regulation of food products made available to the consumers.

RATIONALE

Ph.D. programme in Food Science and Technology would create a new, highly research degree programme in Parbhani that would fill an academic gap between industry and academia. There has never been a Ph.D. programme in Food Technology at Marathwada region of Maharashtra. Recently, with the increase in scope of food technology, in all 14 colleges of Food Technology has been established in Maharashtra. However, due to non-availability of Ph.D. candidates the colleges are lacking to satisfy the criteria for filling of qualified academic staff. Besides, Global scenario demand high level of processing yet India's share for food export remains less than 1.5% which emphasizes the urgent need to develop the need based processing technologies amicable for the regional food processing which require in-depth study and research afforded only by a Ph.D. program. The enhanced depth and quality of students offered by a Ph.D. programme would assist the government in making policy for food and nutritional security through processing.

PROGRAMME DESCRIPTION

1	Degree Offered	:	Ph.D. (Food Technology)
2	System of Education	:	Formal Education with semester system
3	Duration of Program	:	<p>Minimum 6 semester (3 Academic years) Maximum 12 Semester</p> <ul style="list-style-type: none"> • No Ph.D. student be allowed to discontinue the academic programme without completing comprehensive examination • Committee recommends residential requirements of three years for Ph.D. programme • In master's degree at least one full semester should be exclusively devoted to research. <p>There should be a minimum period of two years between synopsis submission and thesis submission.</p>
4	Intake Capacity	:	10 (2 students in each department, including 20% seats for in-service candidates and 25% ICAR quota)
5	Minimum eligibility for Admission	:	<p>i) Master's degree in respective/related subjects ii) 6.50/10 or equivalent OGPA/equivalent percentage of marks for general category candidates and 6.00/10 or equivalent OGPA/equivalent percentage of marks for SC/ST/PH category candidates at Master's degree level.</p>
6	Mode of Admission	:	<p>Entrance exam will be conducted by University based on the syllabus used by ICAR for all India entrance test. Minimum 60 per cent marks should be obtained in Entrance examination to qualify the Ph.D. degree programme. Candidate will be selected on the basis on 80% weightage from Entrance and 20% weightage from Interview.</p> <p>In service candidates should join another university for pursuing Ph.D. programme and must not be enrolled by the university in which they are employed.</p>

* In order to reduce inbreeding SAUs should discourage enrollment of students for three degrees consecutively. One of the three degrees should be from another institution.

7	Reservation of Seats	:	Reservation of seats would be governed by the rules of State Government
8	Maximum permissible course workload per semester	:	18 Credits
9	Minimum credits requirement	:	i. 15 credits of Major courses ii. 8 credits of minor courses iii. 5 credits of supporting course + 2 credits seminar
10	Comprehensive /preliminary exam	:	Non-credit
11	Thesis	:	Non-credit
12	Distribution of credits		
	Major	:	15 Credits
	Minor	:	8 Credits
	Supporting	:	5 Credits
	Seminar	:	2 Credits
	Thesis	:	45 Credits (Non-Credits)
	Total	:	75 Credits (30 Course work + 45 Thesis Non-credits)
13	Semester – wise credit distribution		
	1 st Semester	:	Total – 12 credits <ul style="list-style-type: none"> • (7 Credits) Major courses No. FST-601, FST-603, FST-605 • (5 Credits) Minor courses No. FST-611, FST-619 • (2 Credits) Non Credit Compulsory Courses (NCCC) No. PGS-501, PGS-504
	2 st Semester	:	Total – 08 credits <ul style="list-style-type: none"> • (5 Credits) Major courses No. FST-602, FST-604 • (3 Credits) Minor courses No. FST-612 • (2 Credits) Non Credit Compulsory Courses No. PGS-502, PGS-503
	3 st Semester	:	Total – 06 credits <ul style="list-style-type: none"> • (3 Credits) Major courses No. FST-606 • (3 Credits) supporting courses No. FST-620 • (2 Credits) Non Credit Compulsory Courses No. PGS-505, PGS-506
	4 st Semester	:	Total – 19 credits <ul style="list-style-type: none"> • (2 Credits) supporting courses No. FST-623 • (2 Credits) Doctoral Seminar I & II FST-691(0+1), FST-692(0+1) • (15 Credits) Doctoral Research, FST-699
	5 st Semester	:	• (15 Credits) Doctoral Research, FST-699
	6 st Semester	:	• (15 Credits) Doctoral Research, FST-699
	Total credit load for Doctoral Research	:	Semester 4th, 5th and 6th (15+15+15 =45 Credits)
14	Attendance	:	Minimum 75 %

		Five per cent relaxation in minimum attendance requirement should be given only in the case of indoor hospitalization.
15	Advisory committee	: 4 members (Minimum) (2 from Major area including Chairman and 2 others including Supporting areas) Advisory Committee of student should be formed within one month of registration
16	Examination and Evaluation :	
	Course work	: i) For Major courses one mid-term of 20% marks of theory (internal) and final examination of 80% marks (external) ii) For other courses internal examination with mid-term of 20% marks iii) practical examination should be conducted by course instructors(s) and one teacher nominated by HOD
	Comprehensive/preliminary examination, after completion of 75% of Major and Supporting courses separately i) Question paper setting ii) Viva-voce and assessment	: Written (minimum 65% marks) i) Internal ii) External and Satisfactory/Unsatisfactory
17	Thesis submission	: i) After delivery of thesis seminar ii) Thesis should be submitted only after producing proof of acceptance of at least one research paper and submission of another research paper by the student, based on Ph.D. research work in refereed journals as per NAAS list of journals
18	Thesis Evaluation	: By two External Examiners
19	Thesis Viva-voce	: By one of the External Examiner with advisory committee

20	Final assessment of thesis	:	<p>Satisfactory /unsatisfactory</p> <ul style="list-style-type: none"> Thesis report should be provided to the chairman of the student's advisory committee, who should arrange the conduct of oral examination. The chairperson shall also be responsible for effecting corrections suggested by the external examiner in thesis and give a certificate to this effect. <p>The university should host the thesis data base including abstract on their website</p>
21	Grade Point	:	Ten (10) points grading system should be adopted
	Scale	:	10
	Minimum pass grade in a course	:	7.0
	Minimum OGPA to obtain degree	:	7.0
21	Awards and Medals	:	<p>Gold medal would be awarded only if the student secures at least 8.5 OGPA, clears all courses in first attempt and in the programme having a batch of at least five students. Completing degree clubbing of related departments into group should be done for the consideration of award of gold medal</p>

Details of course work proposed for Ph.D. Degree:

Field of Doctoral degree	Proposed Credits	Minimum Credits
Major Courses	15	15
Minor Courses	08	08
Supporting Courses	05	05
Seminar	02	02
Research	45	45
Total	75	75
Non-credit Compulsory Courses	06	06

Details of course work proposed:

Semester	Course	Course No.	Title	Credits	
Semester I	Major	FST-601	Recent Advances in Grain Processing	3 (2+1)	
		FST-603	Novel Techniques in Food Analysis	2 (1+1)	
		FST-605	Microbial Food Safety and Risk Analysis	2 (1+1)	
	Minor	FST-611	Nutraceuticals and Functional Food	3 (2+1)	
		FST-619	Advances in Protein Technology	2 (1+1)	
	Total course credit				12 (7+5)
	Non credit compulsory courses	PGS 501	Library and Information Services	1 (0+1)	
		PGS 504	Basic Concepts in Laboratory Techniques	1 (0+1)	
Grand Total				14 (7+7)	

Semester	Course	Course No.	Title	Credits	
Semester II	Major	FST-602	Recent Advances in Fruits and Vegetables Processing	2 (1+1)	
		FST-604	Advances in Food Process Engineering	3 (2+1)	
	Minor	FST-612	Advances in Food Biotechnology	3 (2+1)	
	Total course credit				8 (5+3)
	Non-credit compulsory courses	PGS-502	Technical Writing and Communication Skills	1 (0+1)	
		PGS-503	Intellectual Property and its Management in Agriculture	1 (1+0)	
Grand Total				10 (6+4)	

Semester	Course	Course No.	Title	Credits	
Semester III	Major	FST-606	Advanced Food Packaging	3 (2+1)	
	Supporting	FST-620	Project Planning and Implementation	3 (2+1)	
	Total course credit			6 (4+2)	
	Non-credit compulsory courses	PGS-505	Agricultural Research, Research Ethics and Rural Development Programmes		1 (1+0)
		PGS-506	Disaster Management		1 (1+0)
Grand Total			8 (6+2)		

Semester	Course	Course No.	Title	Credits
Semester IV	Supporting	FST-623	Computer Application in Food Research	2 (1+1)
	Seminar	FST-691	Doctoral Seminar I	1 (0+1)
		FST-692	Doctoral Seminar II	1 (0+1)
	Research	FST- 699	Doctoral Research	15(0+15)
Total credit			19 (1+18)	

Semester	Course	Course No.	Title	Credits
Semester V	Research	FST- 699	Doctoral Research	15(0+15)
Total credit			15(0+15)	

Semester	Course	Course No.	Title	Credits
Semester VI	Research	FST- 699	Doctoral Research	15(0+15)
Total credit			15(0+15)	

Total Course Credits Load = 75 Credits (30 Courses Credits + 45 Research Work /Thesis)

Non- Credits Compulsory Courses = 06 Credits

**COURSE STRUCTURE AND SYLLABI FOR PH.D.
(FOOD TECHNOLOGY) PROGRAMME**

Code	Course Title	Credits
Major Courses		
FST-601	Recent Advances in Grain Processing	2+1
FST-602	Recent Advances in Fruits and Vegetables Processing	1+1
FST-603	Novel Techniques in Food Analysis	1+1
FST-604	Advances in Food Process Engineering	2+1
FST-605	Microbial Food Safety and Risk Analysis	1+1
FST-606	Advanced Food Packaging	2+1
Minor Courses		
FST-611	Nutraceuticals and Functional Foods	2+1
FST-612	Advances in Food Biotechnology	2+1
FST-619	Advances in Protein Technology	1+1
Supporting Courses		
FST-620	Project Planning and Implementation	2+1
FST-623	Computer Application in Food Research	1+1
Seminar		
FST 691	Doctoral Seminar I	0+1
FST 692	Doctoral Seminar II	0+1
Research		
FST 699	Doctoral Research (Non-credit)	45
Total Course Credits Load = 75 Credits (30 Courses Credits + 45 Research Work /Thesis)		
Non-Credit Compulsory Courses		
PGS-501	Library and Information Services	0+1
PGS-502	Technical Writing and Communications Skills	0+1
PGS-503	Intellectual Property and Its Management In Agriculture	1+0
PGS-504	Basic Concepts in Laboratory Techniques	0+1
PGS-505	Agricultural Research Ethics and Rural Development Programmes	1+0
PGS-506	Disaster Management	1+0
Non- Credits Compulsory Courses = 06 Credits		

MAJOR COURSES

Recent advances in grain processing

Course No. FST 601

Course Credits: 3 (2+1)

UNIT I

Storage and Handling of Food Grains: Food grain storage structure: recent trends, Problem in bag and bulk storage and their control. Protection against rodents, mould, pests and mites, fumigation processes, aeration and drying during storage, Problems of dust explosion in grain storages, Quality changes of grains during storages and remedial measures.

Wheat: Present scenario of wheat processing industries. Quality testing of wheat grain and the milled product (flour, dough etc). Factors affecting yield and quality of flour. Working of milling equipments. Composite and alternate flours, air classification and their applications. Wheat starch processing, modification and utilization, development of wheat based extruded products.

UNIT II

Rice: Present scenario of rice processing industries. Effect of different factors on milling yield and rice quality. Working of paddy driers . Modern methods of paddy parboiling. Pretreatments to paddy before milling and their advantages. Paddy milling by-products and their utilization. Recent methods of paddy processing and quality testing. Isolation, modification and utilization of rice starch. Modern, convenience and extruded products from rice.

UNIT III

Maize, coarse and pseudo cereals: Modern dry and wet milling methods of maize, working of milling equipment. Production and utilization of corn starch derivatives. Equipments used in the milling of coarse and pseudo cereals. Nutritional products and their recovery in coarse cereals, recent utilization trends in course and pseudo cereals. Latest quality evaluation methods the coarse cereal grains.

UNIT IV

Pulses: Pretreatments given to pulses before milling. Latest quality evaluation methods for pulses. Modern pulse milling methods. Working of machinery and equipment employed in pulses processing. Losses during milling and their control. Utilization trend of pulses in India and abroad.

Oil Seeds: Importance and trends of oil seed processing in India. Machinery and equipments used in the crude oil extraction and its refining. Latest production technology of shortenings, lecithin, confectionery coatings, Imitation dairy products.

Recommended Books:

Title

Author

Fats in food products	Maran
Hand Book Of Cereal Science and Technology	Karel Kulp and Joseph Pante
Modern Cereal Science and Technology	Y. Pomeranz
Maize-Recent Progress in Chemistry and Technology	George E Inglett
Oilseeds and Oil Milling in India (A cultural and History Survey)	Acharya
Post Harvest Technology of Cereals, Pulses and Oilseeds	Chakraverty, A
Pulses – Chemistry, Technology and Nutrition	Ruth H. Matthews
Cereals and Cereals Products	Dendy and Dobraszczyk
Storage of Cereal Grains and their Products	Cryde M. Christensen
Technology of Cereals	N. L. Kent and A. D. Evans
The Chemistry and Technology of Cereals as Food and Feed	Samuel Matz

Recent Advances in Fruits and Vegetable Processing

Course No. FST 602

Course Credits: 2 (1+1)

UNIT I

Physiology of development, ripening and senescence of fruits and vegetables, Harvesting and harvesting indices of fruits and vegetables, post harvest changes of fruits and vegetables, Technological advances in thermal processing of fruit and vegetable.

UNIT II

Minimal processed technology, Fresh-cut Produce, Quality Parameters of Fresh-cut Fruit and Vegetable Products, Safety Aspects of Fresh-cut Fruits and Vegetables, Enzymatic Effects on Flavor and Texture of Fresh-cut Fruits and Vegetables, Preservative Treatments for Fresh-cut Fruits and Vegetables, Application of Packaging and Modified Atmosphere to Fresh-cut Fruits and Vegetables, storage and handling of fresh produce.

UNIT III

Edible coatings for fruits, Selecting edible coatings, Gas permeation properties of edible coatings, Wettability and coating effectiveness, Determining diffusivities of fruits, Measuring internal gas composition of fruits .

Recent techniques in fruits and vegetables: Microwave and radio frequency processing, ohmic and inductive heating, high pressure processing , pulsed electric field, high voltage arc discharge, pulsed light technology, oscillating magnetic fields and ultrasonics..

UNIT IV

Quality attributes of fresh fruits and vegetables, Quality indices of fruit and vegetable juices, Maturity and ripeness indices of fruits and vegetables, Microbiology of fresh and processed fruits and vegetable products, Advances in by-product utilization.

Recommended books:

Author(s)

Food Processing Technology

Food microbiology

Principles of food preservation

Preservation of Fruits and Vegetables

F&V Juice Processing Technology. Vol. III

Food Flavorings

Food Microbiology

Handbook of Analysis of F & V Products

Commercial Fruit Processing

Chemistry and Technology of Soft Drinks and Fruit Juices

Title

P. Fellows

W.C. Frazier.

Fennema, Kerrel

Lal, Siddappa & Tandon

Nelson & Tressler

Ashurst

W.C. Frazier

Ranganna

Luh and Wudruf

Ashurst

Novel techniques in food analysis

Course No. FST 603

Course Credits: 2 (1+1)

UNIT-I

Macronutrients and micronutrients analysis, physico-chemical properties of fruits and vegetables, edible oils, flavouring materials, etc.

UNIT-II

Sensory analysis: laboratory set of equipments, selection of panel member, training of panel member. Judging of quality, difference test, ranking test, sensitivity test, descriptive flavour profile test, threshold value, dilution number, paired comparison test, ANOVA test, dunnet test, hedonic rating test.

UNIT-III

Sensory analysis: laboratory set of equipments, selection of panel member, training of panel member. Judging of quality, difference test, ranking test, sensitivity test, descriptive flavour profile test, threshold value, dilution number, paired comparison test, ANOVA test, dunnet test, hedonic rating test.

UNIT-III

UV-visible and infrared spectroscopy: Absorptivity – Apparent deviations from Beer's law – Double beam spectrophotometer operation – Sources of radiation – Detectors – Photo metric accuracy – Instrumentation, - Chemical applications – Qualitative analysis – determination of ligand/metal ratio in a complex Quantitative analysis – photo metric titration. Introduction-origin of IR spectra-instrumentation, group frequencies, applications of IR spectra analysis spectral data of alcohols-aldehydes and ketones –carboxylic acids –amines –amino acids –proteins.

Recommended Books:

Title	Author
Hand book of Analysis & Q.C. for Fruits & Vegetables products	Ranganna
Food microbiology	Frazier
Instrumental methods of analysis	B.K Sharma
Spectroscopic analysis	Y.R.Sharma
Instrumental methods of analysis	Chatwal

Advances in Food Process Engineering

Course No. FST 604

Course Credits: 3 (2+1)

UNIT- I

Units and dimensions, concept of entropy, Energy, Exergy, Degradation of exergy, Material and energy balances. Rules for the efficient conversion of energy and materials, Material and energy balance diagrams. Technologies for energy conservation, Numerical problems.

Novel evaporation/ dehydration techniques, New direction in evaporation and drying concentration, cyclic pressure freeze drying, spray drying. Microwave drying and vacuum drying, osmotic dehydration efficient drying systems, infrared heating, freezing of foods, freeze concentration and drying, freezing point curves, methods of freeze concentration, design problems.

UNIT-II

Fluid flow operations and food rheology: Properties of fluids, types of flow, Reynolds number, viscosity, concept of boundary layer, basic equations of fluid mechanics, fluid flow, valves, flow meters, manometers, measurement of flow and pressure. Different types of fluid energies, Euler's equation Derivation of Bernoulli equation, Hydraulic coefficients, Practical applications of Bernoulli's equation, Rheology, stress strain diagram, types of fluids, time independent fluids, time dependent fluids. Viscoelastic fluids, Flow of viscous fluid between two parallel plates, Flow of viscous fluid through circular pipe or derivation of Hagen-Poiseuille equation or theory of capillary viscometer, Coefficient of friction or fanning friction factor or skin friction factor, Energy losses in pipes, Drag coefficient, Stokes law (laminar flow around a sphere), Viscometry, Capillary tube viscometer, Rotational viscometer, Ostwald viscometer, Falling sphere resistance method, Cone and plate type viscometer, Circular disc viscometer, Laminar flow through porous media (Darcy's law), Pressure drop in flow through porous media, Pumps for fluid flow, Viscoelastic fluids, Static (constant stress or strain) measurement method, Maxwell model, Kelvin-Voigt model, Burger model: (or four element model), Dynamic (varying stress or strain) or oscillatory measurements method, Textural profile analysis, numerical Problems

UNIT-III

Different types of membrane processes, physical characterisation of membrane structure, driving force for membrane separation, concept of partial molar properties and chemical potential, fugacity, activity of solution, activity coefficient, general mass transfer equation during mass transfer, Fick's law of diffusion mass transfer, pore diffusion model, types of membranes, membrane modules configurations, derivation of equation for osmotic pressure for concentrated and dilute solutions, detailed description of microfiltration, ultrafiltration, nanofiltration, reverse osmosis etc. Derivation of various mass transfer equations for mass transfer through membrane, polarization layer by concentration and fouling, factors affecting reverse osmosis and other membrane separation processes, applications of various membrane separation processes.

UNIT-IV

Extrusion cooking - recent developments, methods, equipment, design criteria of extruders. Engineering aspects of single and twin screw extrusion cooking; Non-thermal processing: Microwave, irradiation, ohmic heating, pulsed electric field reservation, hydrostatic pressure technique.

Recommended Books:

Title	Author
Agricultural Process Engineering	Henderson S & Perry SM
Chemical engineering	J.M. Coulson and J.F. Richardson
Chemical Engineering Handbook	Ed. Robert H. Perry, Cecil H. Citon
Chemical Engineering. VolS. II, IV	Coulson JM & Richardson JF
Design and Management for energy conservation	O'Callaghan P W
Essentials of Food Processing Engineering	C.Gopala Rao,
Extrusion cooking Technology.	Ronald Jowitt
Food Engineering Operations	Brennan JG, Butters JR, Cowell ND & Lilly AEI
Food Processing Technology: Principle and Practice	Fellows P.
Fundamentals of Food Process Engineering	Singh RP
Introduction to Food Engineering	Singh RP & Heldman DR
Transport Process and Unit Operations	Geankoplis J Christie.
Unit Operation of Agricultural Processing	Sahay KM & Singh KK.
Unit Operations in Food Processing	Earle RL
Unit Operations in Food Processing	R.L.Eave,
Unit Operations of Chemical Engineering	McCabe WL & Smith JC
Unit Operations of Chemical Engineering	W.L.Mc Cabe, J.C. Smith and P. Harriot,

Microbial food safety and risk analysis

Course No. FST 605

Course Credits: 2 (1+1)

UNIT-I

An Overview of Food Safety: Safe Food definition, Food Hazards, Chemical Hazards, Food Allergens, Drugs, Hormones, and Antibiotics in Animals, Naturally Occurring Toxins, Pesticides, Microbiological Hazards, Bacteria, Viruses, Protozoa and Parasites, Bovine Spongiform Encephalopathy (BSE), Physical Hazards, Factors That Contribute to Foodborne Illness, Demographics, Consumer Lifestyles and Demand, Food Production and Economics, New and Evolving Pathogens, History of Food Safety, The Role of Food Preservation in Food Safety

UNIT-II

Issues in Food Safety, Genetically Engineered Foods: Regulation, The Case against and in favor of Food Biotechnology, Bovine Somatotropin, Food Irradiation, pesticide residues in food.

UNIT-III

Drinking water quality: History, Water Supply, Hazards to the Water Supply, Regulation, Restaurant Food Safety: Regulating the Industry, associated hazards, education and corrective action. National and International Food safety Regulations

UNIT-IV

Introduction to Risk Analysis: Background, changing food safety environment, evolving food safety systems, an abundant array of hazards, Increasing demands on national food safety authorities. Risk Analysis: Components of risk analysis, carrying out risk analysis, Risk analysis at the international and national levels, Essential characteristics of risk analysis, Benefits for national governments of using food safety risk analysis. Risk management: Introduction, perspectives on risk, generic risk management framework, Understanding risk management, Preliminary risk management activities, Selection of risk management options, Implementation of the risk management decision, Monitoring and review. Risk Assessment: Introduction, Scientific approaches for assessing risks, Responsibilities of risk managers in commissioning & administering a risk assessment, Time and resources, Risk assessment, Integrating risk assessment and economic assessment. Risk Communication: Introduction, Understanding risk communication, Key communication elements of food safety risk analysis.

Recommended Books:

Title	Authors
Pathogens and Toxins in Food: Challenges and Interventions	Vijay K. Juneja, John N. Sofos
Microbial Hazard Identification in Fresh Fruits and Vegetables	James J.

Food Biotechnology (2nd Edition)

Kalidas Shetty, Gopinadhan P.,
Anthony P. and Robert E.L.

Microbial Stress Adaptation and Food Safety

Ahmed E. Yousef, Vijay K. Juneja

Make It Safe: A Guide to Food Safety

CSIRO

Advances in Food Protection

Magdy Hefnawy

Microbial Food Safety: An Introduction

Omar A. Oyarzabal, Steffen Backert

Advanced food packaging

Course No. FST 606

Course Credits: 3 (2+1)

UNIT - I

Introduction to packaging – Definition – used for packaging – Factors involved in the creation of food package, designing successful packaging – Packaging materials and forms – Testing of packaging materials, paper, paper board, plastics, glass containers, metal packaging.

UNIT - II

Basic types of food processing for packaging – Heat processing (including irradiation), high barrier plastics packaging, Aseptic packaging, packaging for microwavable foods, Irradiation, UV – Light, Ultrasonic, High pressure techniques – Dehydration - Reduction of available water, Active packaging systems – Freezing, commercial freezing methods, protection needed by frozen foods.

UNIT - III

Packaging of fresh and chilled foods : Meat, Shell fish and dairy products and the package requirements – vacuum and modified atmosphere packaging. Packaging of frozen foods – package requirements for frozen fish, and dairy products.

UNIT - IV

Packaging of fresh fruits and vegetables. Details of packaging of Fruits & Vegetables products packaging Materials, packaging methods, problems related in packaging & Quality control, testing of packaging materials and importance of packaging in Food & Vegetables.

UNIT - V

Packaging of whole grain products : milled grain produced prepared mixes, paste, biscuits, bread and backed foods. packaging styles, wrapping materials and methods.

UNIT - VI

Packaging Machinery Production and packaging line requirements – Bottling, layout of bottling line and details of individual steps on the automatic line – canning, details of individual steps in canning process – wrapping operations – form, fill and seal machines and labeling machines.

UNIT - VII

Biopackaging : Use of biopolymers in packaging, properties and applications of biopackaging, Recycling, reuse and disposal of food packaging materials.

Recommended Books:

Title	Author
Principles of Food Packaging	Stanley Sacharow and Roger C.Griffin
Food packaging and preservation	Ed. M. Mathlouthi
A Hand Book of Food Packaging	EIRI

MINOR COURSES

Nutraceuticals and Functional Foods

Course No. FST 611

Course Credits: 3 (2+1)

UNIT-I

Introduction: Nutraceuticals and Functional Foods, driving forces for nutraceutical and functional food market, classification of functional foods, example of functional components with their potential benefits. Some examples of functional food products, 3G functional food.

UNIT-II

Major nutraceuticals: Isoflavones: Source and Metabolism, Lycopene: Food Sources, Properties, and Health, Garlic: The Mystical Food in Health Promotion, Grape Wine and Tea Polyphenols in the Modulation of Atherosclerosis and Heart Disease, Dietary Fiber and Coronary Heart Disease, Omega-3 fatty acid and Lipoprotein Metabolism, Omega-3 Fish Oils and Insulin Resistance, Antioxidant Vitamin and Phytochemical Content of Fresh and Processed.

UNIT-III

Osteoarthritis: Nutrition and Lifestyle Interventions, Omega-3 Fatty Acids, Mediterranean Diet, Probiotics, Vitamin D, and Exercise in the Treatment of Rheumatoid Arthritis, Skeletal Effects of Soy Isoflavones in Humans: Bone Mineral Density and Bone Markers, Applications of Herbs to Functional Foods, Conjugated Linoleic Acids: Biological Actions and Health, Olive Oil and Health Benefits, The Role of α - and γ -Tocopherols in Health, Probiotics and Prebiotics, Exopolysaccharides from Lactic Acid Bacteria: Food Uses, Production, Chemical Structures, and Health Effects, Omega-3 Fatty Acids, Tryptophan, B Vitamins, SAME, and Hypericum in the Adjunctive Treatment of Depression, Protein as a Functional Food Ingredient for Weight Loss and Maintaining Body Composition, Nutraceuticals and Inflammation in Athletes, Coenzyme Q10: A Functional Food with Immense Therapeutic Potential

UNIT-IV

Nutraceutical Stability Concerns and Shelf Life Testing, Nutraceutical and Functional Food Application to Nonalcoholic Steatohepatitis, Marketing and Regulatory Issues for Functional Foods and Nutraceuticals, Obesity Policy: Opportunities for Functional Food Market Growth

Recommended Books:

Title

Author

Nutraceutical

Brian Lockwood

Advances in Food Biotechnology

Course No. FST 612

Course Credits: 3 (2+1)

UNIT-I

Food Microbiology, Principles of Biochemistry and Molecular Biology, Fermentation Technology and Bioreactor Design, Process Developments in Solid-State Fermentation for Food Applications, Metabolic Engineering of Bacteria for Food Ingredients, Technologies Used for Microbial Production of Food Ingredients, Production of Carotenoids by Gene Combination in *Escherichia coli*, Production of Amino Acids: Physiological and Genetic Approaches, Biotechnology of Microbial Polysaccharides in Food, Genetics of Dairy Starter Cultures, Genetic Engineering of Baker's Yeast: Challenges and Outlook, The Biotechnology of Wine Yeast, Stress Tolerance, Metabolism, and Development: The Many Flavors of Trehalose, Production of Pectinases and Utilization in Food Processing, Biotechnology of Citric Acid Production, Microbial Biotechnology of Food Flavor Production, Microbial Production of Oils and Fats, Potential Uses of Cyanobacterial Polysaccharides in the Food Industry, Food Applications of Algae,

UNIT-II

Plant and animal food applications and functional foods: Methods in Plant Tissue Culture, Clonal Screening and Sprout Based Bioprocessing of Phenolic, Phytochemicals for Functional Foods, Genomic Basics for Food Improvement, Molecular Design of Soybean Proteins for Enhanced food Quality, Genetic Modification of Plant Starches for Food Applications, Bioprocessing of Starch Using Enzyme Technology, Genetic Modification of Plant Oils for Food Uses, Molecular Biotechnology for Nutraceutical Enrichment, Potential Health Benefits of Soybean Isoflavonoids and Related Phenolic Antioxidants, Functional Phytochemicals from Cranberries: Their Mechanism of Action and Strategies to Improve Functionality, Biotechnology of Nonnutritive Sweeteners, Enzyme Technology for the Dairy Industry, The Production, Properties, and Utilization of Fish Protein Hydrolysates,

UNIT-III

Food safety, novel bioprocessing, traditional fermentations, and regulatory issues: Molecular Evolution and Diversity of Food Borne Pathogens, Genetics and Physiology of Pathogenicity in Food Borne Bacterial Pathogens, Biofilm Production by *Listeria monocytogenes*, Application of Microbial Molecular Techniques to Food Systems

UNIT-IV

Control of Food Borne Bacterial Pathogens in Animals and Animal Products through Microbial Antagonism, Bacteriocins: Antimicrobial Activity and Applications, Genetic Characterization of Antimicrobial Peptides, Phenolic Antimicrobials from Plants for Control of Bacterial Pathogens, Genetic Mechanisms Involved in Regulation of Mycotoxin Biosynthesis, Application of ELISA Assays for Detection and Quantitation of Toxins in Foods, Biotransformations as Applicable to Food Industries, Fermentation Biotechnology of Traditional Foods of the Indian Subcontinent, Anaerobic Processes for the Treatment of Food Processing Wastes

UNIT-V

International Aspects of the Quality and Safety Assessment of Foods Derived by Modern Biotechnology, Patenting Inventions in Food Biotechnology

Recommended Books:

Title

Applications of Biotechnology for functional foods

Functional foods and biotechnology

Food Biotechnology

Author

Pew Initiative on Food
and Biotechnology

Kalidas Kalidas Shetty, Gopinadhan
Paliyath, Anthony L. Pometto and
Robert E. Levin

Kalidas Shetty, Gopinadhan Paliyath,
Anthony Pometto, Robert E. Levin

Advances in Protein Technology

Course No. FST 619

Course Credits: 2 (1+1)

UNIT-I

Characteristics of proteins from plant, animal and microbial origins. Denaturation of proteins: Effect of processing parameters on denaturation. Effect of denaturation on the physicochemical and biological properties of proteins in food systems.

UNIT-II

Protein interactions with food constituents: protein-protein interactions. Protein-lipid interactions, protein-polysaccharide interactions, and protein-ion interactions. Significance of protein interactions: formation and stabilization of casein micelle, stability of concentrated milk products, and role of protein in food structure.

UNIT-III

Protein Nutrition: Recent concepts in protein nutrition in man: Enzyme development and protein digestion. Effect of processing on nutritive value of proteins. Mass and institutional feeding programs: Amino acid fortification of foods and concepts in protein supplementation and complementation.

UNIT-IV

Protein hydrolysates-- Production and processing; De-bittering of protein products; Bioactive peptides: their production and properties. Recent Technologies: Augmentation of world resources for protein foods: protein from plants, animals and microorganisms. Textured vegetable proteins and spun fibre technology: Extrusion cooking selection of ingredients and formulation, control of operational parameters, microstructure of extrusion cooked foods.

UNIT-UNIT-V

Soyprotein: composition, utilization, edible soybean flour and grits, full fat soy flour or grits, defatted soy flour and grits, soybean protein concentrate, soybean protein isolate, soy milk, soy micro powder, soy yoghurt, texturized soy protein. Fish Protein Concentrate: introduction, process of manufacturing, Protein content of FPC, shelf life, Groundnut and other oilseed protein quality, nutrition and shelf life

Recommended Books

Title

Encyclopaedia of Food Science, Food Technology and Nutrition

Food Chemistry

Technology of production of edible flours and protein products from soybeans

Author

Academic press

Fennema OR

Zeki Berk

SUPPORTING COURSES

Project Planning and Implementation

Course No. FST-620

Course Credits: 3 (2+1)

Thoryy

UNIT I

An introduction to project management: An overview of project management. The differences between Product, Project and Program management, Industrial, R&D and social security projects.

UNIT II

Successful Initialization and Project Planning: Defining the project scope. Establishing the project scope and defining project deliverables. Defining and Sequencing of Project Deliverables. Project scheduling techniques, Market research and forecasting. GMP and HACCP.

UNIT III

Resource Planning: Determining resource requirements and acquiring those resources, Source of finance, Debt-equity ratio, Debt service coverage ratio, ROI, RONW, Process of soliciting and selecting vendors for material and services for the project. Cost Management. Establishing the project budget and analyzing budget variances, techno-economic feasibility analysis.

UNIT IV

Execution of the Project Plan and Evaluating Project Progress: Execution of the project plan and activities required to create the project team, monitor progress against the plan, and keep the project on track. Capacity utilization, Break even point.

UNIT V

Risk Identification and Analysis: Identify risky events, measure the element of risk, and develop responses to high-risk events. Establishing the Project Management Team Identifying project team members, and structuring a successful project team. Keeping the Project on Track The quality process, Project's quality standards and how performance to those standards will be measured. Managing Project Change Handling formal and informal change, how to identify and evaluate change, and incorporate change into the project plan.

Practical

Preparation of a model detailed project report for a small scale food processing unit and its power point presentation, Case studies of various food products, projections planning for sales target achievements, Risk analysis for financial and technical feasibilities of the projects, Project appraisal methods as applied to selected projects.

Recommended Books:

Pavlyak MM.2000. *Systems Survival Guide*. Ruby Moon Press.

Thomsett TC.1990. *The Little Book of Project Management*. American Management Association.

Computer Applications in Food Research

Course No. FST-623

Course Credits:2 (1+1)

Theory

UNIT I

Importance of Computerization and IT in Food Industries Computers, operating environments and information systems for various types of food industries; Principles of Communication.

UNIT II

Role of Computer in Optimization: Introduction to operation Research; A Computer Oriented Algorithmic approach; Queuing systems and waiting models; PERT, CPS and CPM.

UNIT III

Food Process Modeling and Simulation; CAD and CAM in Food Industry: instrumentation, process Control, inventory Control, Automation, Robotics, Expert system and artificial intelligence.

Practical

Applications of MS Excel to solve the problems of food technology: Statistical quality control, Sensory evaluation of food, and Chemical kinetics in food processing; Use of word processing software for creating reports and presentation; Familiarization with the application of computer in food industries -Milk plant, Bakery Units, Fruit & Vegetable processing Unit; Familiarization with software related to food industry; Ergonomics application in the same; Visit to Industry and case study problems on computer.

Recommended Books:

Gillett BE. *Introduction to Operation Research* (A Computer Oriented Algorithmic Approach).
Groover MP & Zimmers EW. 1987. *CAD/CAM: Computer Aided Design and Manufacturing*.
Prentice Hall.
Singh RP. 1996. *Computer Applications in Food Technology*. Academic Press.

SEMINAR

FST 691	Doctoral Seminar I	0+1
FST 692	Doctoral Seminar II	0+1

RESEARCH

FST 699	Doctoral Research (Non-credit)	45
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NON-CREDIT COMPULSORY COURSES

Library and Information Services

Course No. PGS-501

Course Credits:1 (0+1)

Objective

To equip the library users with skills: to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

Practical

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized library services; Use of Internet including search engines and its resources; e-resources access methods.

Technical Writing and Communications Skills

Course No. PGS-502

Course Credits:1 (0+1)

Objective

To equip the students/scholars with skills to write dissertations, research papers, etc.

To equip the students/scholars with skills to communicate and articulate in English (verbal as well as writing).

Practical

Technical writing

Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

Communication skills

Grammar (Tenses, parts of speech, clauses, punctuation marks); Error analysis (Common errors); Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers.

Recommended Books:

Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek, Chandigarh.

Chicago Manual of Style. 14th Ed. 1996. Prentice-Hall of India, New Delhi.

Collins' Cobuild English Dictionary. 1995. Harper Collins, New York.

Gibaldi, Joseph. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press, New Delhi.

Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford UP, Oxford.

Krishna Mohan 2005. Speaking English Effectively. Macmillan India, New Delhi.

Mills Gordon H & John A Walter. 1970. Technical Writing. 3rd Ed. Holt, Rinehart & Winston, New York.

Intellectual Property and its Management in Agriculture

Course No. PGS-503

Course Credits:1 (1+0)

Objective

The main objective of this course is to equip students and stakeholders with knowledge of intellectual property rights (IPR), related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

Theory

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

Recommended Books:

- Erbisch FH & Maredia K. 1998. Intellectual Property Rights in Agricultural Biotechnology. CABI, Wallingford.
- Ganguli, Prabudha. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill, New Delhi.
- India, Ministry of Agriculture. 2004. State of Indian Farmer. Vol. 5. Technology Generation and IPR Issues. Academic Foundation, New Delhi.
- Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies, New Delhi.
- Rothschild, Max & Newman, Scott (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI, Wallingford.
- Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya, Delhi.
- The Indian Acts - Patents Act, 1970 & amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 & amendments; Layout Design Act, 2000; PPV & FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003.

Basic Concepts in Laboratory Techniques

Course No. PGS-504

Course Credits:1 (0+1)

Objective

To acquaint the students about the basics of commonly used techniques in laboratory.

Practical

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micropipettes and vaccumets; washing, drying and sterilization of glassware; Drying of solvents/chemicals. Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions; Preparation of different agro-chemical doses in field and pot applications; Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sandbath, water- bath, oil-bath; Electric wiring and earthing. Preparation of media and methods of sterilization; Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy.

Suggested Readings

Furr AK. 2000. *CRC Hand Book of Laboratory Safety*. CRC Press. Gabb MH & Latchem WE. 1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.

Agricultural Research, Research Ethics and Rural Development Programmes

Course No. PGS-505

Course Credits:1 (1+0)

Objective

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

Theory

UNIT I

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

UNIT II

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

UNIT III

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organisations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

Recommended Books:

Bhalla GS & Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.

Punia MS. *Manual on International Research and Research Ethics*. CCS, Haryana Agricultural University, Hisar.

Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.

Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ.

Disaster Management

Course No. PGS-506

Course Credits:1 (1+0)

Objective

To introduce learners to the key concepts and practices of natural disaster management; to equip them to conduct thorough assessment of hazards, and risks vulnerability; and capacity building.

Theory

UNIT I

Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, Drought, Cyclone, Earthquakes, Landslides, Avalanches, Volcanic eruptions, Heat and cold Waves, Climatic Change: Global warming, Sea Level rise, Ozone Depletion

UNIT II

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire. Oil fire, air pollution, water pollution, deforestation, Industrial wastewater pollution, road accidents, rail accidents, air accidents, sea accidents.

UNIT III

Disaster Management- Efforts to mitigate natural disasters at national and global levels. International Strategy for Disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, Community-based organizations, and media. Central, State, District and local Administration; Armed forces in Disaster response; Disaster response: Police and other organizations.

Recommended books:

Gupta HK. 2003. *Disaster Management*. Indian National Science Academy. Orient Blackswan.

Hodgkinson PE & Stewart M. 1991. *Coping with Catastrophe: A Handbook of Disaster Management*. Routledge.

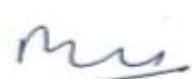
Sharma VK. 2001. *Disaster Management*. National Centre for Disaster Management, India

Committee members:

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2. Prof. H.W. Deshpande
3. Prof. R.B. Kshirsagar
4. Mr. Syed Imran Hashmi



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