

Ph. D.
IN
FOOD TECHNOLOGY
SYLLABUS



DEPARTMENT OF FOOD TECHNOLOGY

**Dr. KHEM SINGH GILL AKAL COLLEGE OF
AGRICULTURE
ETERNAL UNIVERSITY, BARU SAHIB, HP-173101
2017**

Ph.D. Programme in Food Technology at the Eternal University Baru Sahib, Himachal Pradesh

Compulsory Courses						
Semester	Course No.	Course Title	Theory	Seminar	Practical	Dissertation
Sem-I	FT-609	Research Methodology	3	0	0	0
Sem-I	FT-611	Advances in Food Analysis and Quality Control	3	0	0	0
Sem-I	FT-691	Seminar	0	1	0	0
Sem-I	FT-701	Dissertation	0	0	0	5
Optional Courses (Any two courses taking one from each option)						
Option-I						
Sem-I	FT-612	Recent Advances in Cereals, Pulses & Oilseeds Processing	3	0	0	0
Sem-I	FT-613	Recent Advances in Fruits & Vegetables Processing	3	0	0	0
Option-II						
Sem-I	FT-614	Recent advances in Food Processing and Technology	3	0	0	0
Sem-I	FT-615	Recent Advances in Dairy Science & Technology	3	0	0	0
Sem-I	FT-616	Recent Advances in Food Biotechnology	3	0	0	0
		Semester-I Total	12	1	0	5
Sem-II	FT-692	Synopsis Seminar	0	1	0	0
Sem-II	FT-701	Dissertation	0	0	0	15
Sem-III	FT-701	Dissertation	0	0	0	15
Sem-IV	FT-701	Dissertation	0	0	0	15
Sem-V	FT-701	Dissertation	0	0	0	15
Sem-VI	FT-701	Dissertation	0	0	0	15
Total			12	2	0	80

NOTE: In Semester II, there will be Comprehensive examination (will be evaluated satisfactory/unsatisfactory), each student will have to achieve 50% marks in comprehensive written examination and satisfactory performance in oral examination. There will be synopsis writing and approval of synopsis by research degree committee.

In III, IV, V and VI semesters, students will undertake his/her research work by taking 15 credit hours each semester. The major advisor will evaluate his/her work in each semester and clear the credit hours by evaluating satisfactory/unsatisfactory, depending upon the work undertaken by the student during the semester.

Examination schedule: As applicable to other post- graduate courses of eternal University

FT-609 Research Methodology
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

Units*	Contents	Lectures
1.	History, myths and ethnic practices; need, importance and impact of research; types of research; research process	3
2.	Synopsis writing; Selecting research problem; formulation of research projects; survey of literature; allied and critical literature; research infrastructure; experimental designs; sampling designs; recording of observations ; measurement and scaling techniques; GLPs	4
3.	Formulation and types of hypothesis; collection, maintenance, storage and analysis of data; measures of central tendencies and relationships and error analysis; tests of significance	6
4.	Compilation and presentation of results, Writing of manuscripts; research reports and thesis; organization of reference material using endnote; bibliography; plagiarism; IPR and patent application	6
5.	Financial support and various funding agencies; Multidisciplinary, multi-institutional research network initiatives; writing research proposal	3
6	Computer and informatics; introduction; word processing, excel, power point presentation; graph and figure plotting; web browsing; information resources and various databases.	6
7	Demonstration of departmental research activities and instrumentation	7
8.	Writing a review article on topic of interest or suggested by research committee.	7
Total		42

*Unit 1-4: common for all streams. Unit7-8: offered by concerned department.

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication
1.	Research methodology- Methods and Techniques: C R Kothari, New Age International, 2 nd ed., 2004.	1985
2.	Ranjeet Kumar, Research methodology-A step by step guide for beginners, 2 nd edn. Pearson Education.	2005
3.	Research Methods and Statistics, Sherri Jackson, Wadsworth Cengage Learning.	2009
4	Research methodology for biological sciences: N Gurumani, MJP Publishers.1 st ed	2013
5	Research methodology in medical and biological sciences: P Laake, H benestad, B Olsen, Elsevier, 1 st ed.	2007

FT-611 Advances in Food Analysis and Quality Control
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

S. No.	Particulars	lectures
1.	Applications of the following in the food analysis: Microscopic techniques in food analysis: light, phase contrast, fluorometry, confocal, Scanning Electron Microscopy (SEM), Transmission Electron microscopy (TEM), Laser particle size analysis.	7
2.	Thermal methods in food analysis: Differential scanning calorimetry, Differential thermal analysis.	5
3.	Radioisotopy- radioactive tracer techniques, radio immunological assays, safety.	5
4.	Chromatographic methods in food analysis: Column, size exclusion and ion exchange. TLC, adsorption, gel filtration, ion-exchange, affinity chromatography, High Performance liquid chromatography, Gas liquid chromatography, GC-MS, Visible and ultraviolet spectroscopy, FTIR spectroscopy, Flame photometry and atomic absorption spectroscopy.	7
5.	X-ray methods: Diffraction, Fluorescence, Electrophoresis, 2DE, capillary zone electrophoresis, pulsed-electric field, gel electrophoresis.	7
6.	Spectroscopy- UV-visible, Infrared spectroscopy, Nuclear magnetic resonance (NMR).	5
7.	Rheology : Textural properties, viscosity, Rheo-optics. Separation techniques : microfiltration, sedimentation, ultra-centrifugation, Reverse osmosis, ultrafiltration, nanofiltration, microfiltration.	6
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication /Reprint
1.	Clifton M & Pomeranz Y. Food Analysis - Laboratory Experiments. AVI Publication.	1988
2.	Gruenwedel, DW & Whitaker JR. Food Analysis Principles and Techniques. Vol. I, II, III & IV. Marcel Dekker	1984
3.	Leenheer AP, Lambert WE & van Bocxlaer JF. Modern Chromatographic Analysis of Vitamins. 3rd Ed. Marcel Dekker.	2000
4.	Nollet LML. Handbook of Food Analysis. Vol. I., Marcel Dekker.	1986.

5.	Pomeranz and Clifton. Food Analysis. Theory and Practice 3rd Ed. Chapman and Hall, New York.	2000
6.	Rickwood, D. and Hames, B.D., "HPLC, Gel Electrophoresis, Oligonucleotide Synthesis, Solid Phase Peptide Synthesis, The Practical Approach Series", IRL Press.	1994
7.	Campbell, I.D., and Dwek, R.A., "Biological spectroscopy", Benjamin Cummins.	1984

FT-612 Recent Advances in Technology of Cereals, Pulses & Oilseeds
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

S. No.	Particulars	Lectures
1.	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.	8
2.	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.	7
3.	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.	8
4.	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 coarse and pseudo cereals. Latest quality evaluation methods the coarse cereal grains.	7
5.	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.	7
6.	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.	5
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication
1.	Post-Harvest Technology of Cereals, Pulses and Oilseeds by Chakraverty, A	1988
2.	The Chemistry and Technology of Cereals as Food and Feed Samuel Matz	1991
3.	Maize-Recent Progress in Chemistry and Technology by George E Inglett	1982
5.	Modern Cereal Science and Technology by Y. Pomeranz	1990

6.	Storage of Cereal Grains and their Products by Cryde M. Christensen	1982
7	Hand Book Of Cereal Science and Technology by Karel Kulp and Joseph P Pante	2000
9	Technology of Cereals by N. L. Kent and A. D. Evans	1994

FT-613 Recent Advances in Fruits and Vegetables Processing
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

S. No.	Particulars	No. of lectures
1.	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.	8
2.	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.	9
3.	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	8
4.	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..	9
5.	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.	8
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication
1.	Food Processing Technology by P. Fellows	2009
2.	Food microbiology by W.C. Frazier.	1958
3.	Principles of food preservation by Fennema, Kerrel	1975
4.	Preservation of Fruits and Vegetables by Lal, Siddappa & Tandon	2015
5.	F&V Juice Processing Technology. Vol. III by Nelson & Tressler	1980
6.	Handbook of Analysis of F & V Products by Ranganna	2001
7.	Chemistry and Technology of Soft Drinks and Fruit Juices by Ashurst	2016

FT-614 Recent advances in Food Processing and Technology
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

S. No.	Particulars	No. of Lecture
1.	Microwave and Radio Frequency Processing: Mechanism of Heat Generation, Applications in Food Processing: Microwave Blanching, Sterilization and Finish Drying. Electrical Resistance Heating of foods. High Voltage Pulse Techniques in Food Processing.	8
2.	High Pressure processing: Concept, Equipments for HPP Treatment, Mechanism of Microbial Inactivation and its Application in Food Processing.	5
3.	Ultrasonic Processing: Properties of Ultrasonic, Application of Ultrasonic in Processing.	5
4.	Membrane Technology: Micro-filtration, Ultra-filtration, Nano-filtration and Reverse Osmosis and their Application.	6
5.	Principles and Applications of Hurdle Technology. Aseptic Processing. Supercritical Fluid Extraction and its Application.	5
6.	Nanotechnology: Principles and Applications in Foods. Biodegradable Food Films and Coatings and Applications.	6
7.	Newer techniques in food processing: Application of technologies of high intensity light, pulse electric field, ohmic heating, IR heating, inductive heating and pulsed X-rays in food processing and preservation.	7
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication/ Reprint
1.	Barbosa-Canovas. Novel Food Processing Technologies. CRC.	2002
2.	Dutta AK & Anantheswaran RC. Hand Book of Microwave Technology for Food Applications.	1999
3.	Frame ND. (Ed.). The Technology of Extrusion Cooking. Blackie.	1994
4.	Gould GW. New Methods of Food Preservation. CRC.	2000
5.	Shi J. (Ed.). Functional Food Ingredients and Nutraceuticals: Processing Technologies. CRC.	2006
6.	Gibson GR & William CM. Functional Foods - Concept to Product.	2000
7.	Goldberg I. Functional Foods: Designer Foods, Pharma Foods.	1994
8.	Robert EC. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman.	2006

FT-615 Recent advances in Dairy Science and Technology
(Semester I)

Credits: 3 + 0

Contact Hours: 42 + 0

Mid-Session Exam: 40

End-Semester Exam: 60

Details of Course:

S. No.	Particulars	No. of Lectures
1.	Homogenization of milk: Principle of homogenization, Effect of homogenization, Technical execution, valves and pumps, single and double stage homogenizers, care and maintenance of homogenizers, Efficiency of homogenization, design principles of homogenizers, operation and maintenance, application of homogenization in dairy industry. Recent advances in homogenization.	8
2.	Tanks, Pumps, Stirrer mixtures and Centrifugation: Designs and equipment of tank, types of tanks, pumps in dairy industry, Agitation and mixing, construction of agitators and patterns of flow. Separation by gravity and centrifugal force, clarifiers and separators, centrifugal separator and efficiency of separation, flow rate and power consumption.	8
3.	Thermal processing of milk Pasteurization of milk: Holding methods, Agitation of liquids, HTST pasteurizer and design principle and thermal death kinetics, care and maintenance, Advantages of HTST pasteurization, Vaccination, UHT processing of milk, quality changes during processing of milk. Concentration of milk Evaporator, Food properties in relation to evaporator performance, Construction and types of evaporator, heat and mass balance in single and multiple effect evaporator, performance characteristics of evaporators and their selection criteria, steam economy. Recent advances in evaporating techniques.	10
4.	Spray and drum drying: Theory of drying, estimation of drying rates and drying time, drying equipments, particle size calculation, design of spray and drum dryer, skim milk and whole milk powders manufacturing methods. Fluidized bed drying, Principles of fluidized bed method, Types of fluidized bed drier, Drying and cooling times in fluidized bed; Freeze drying; Agglomeration, Problems of reconstitution, Methods of Agglomeration, The effect of drying on milk products. Recent advances in drying.	9
5.	Dairy products: Butter; ghee; Cheese; Casein and its derivatives; Condensed and evaporated milk, Traditional products; Whey powder, protein concentrate and isolate; Lactose their composition, standards, manufacturing, process control and quality control parameters.	7
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication/Reprint
1.	Dairy products by Lampart, Lincoln M.	1975
2.	Milk and Milk Products by Eckles, Comb and Macy	1957
3.	Ice Cream by Arbuckle	2000
4.	Dairy Engineering by John T Bowen	1925

FT-616 Recent Advances in Food Biotechnology
(Semester I)

Credits: 3 + 0
Contact Hours: 42 + 0

Mid-Session Exam: 40
End-Semester Exam: 60

Details of Course:

S. No.	Particulars	Lectures
1.	Introduction Concept of biotechnology, historical developments, Interdisciplinary nature of biotechnology, scope and present status of biotechnology in India in relation to food technology and its general applications.	5
2.	Fermentation and Fermenter Design Types of fermentation-submerged, surface and solid substrate fermentation, factors affecting fermentations, Concept of fermenter and its design, scale up of fermentation, problems in scale up, Role of fermentation in food preservation, Developments in solid-state fermentation for food applications.	5
3.	Production of Alcoholic Beverages Introduction, classification of alcoholic beverage, Production of alcoholic beverages: raw materials, culture, fermentation technology of non-distilled beverages (beer and wine) and distilled alcoholic beverages (brandy, whiskey, vodka, rum, gin)	5
4.	Production of Single Cell Proteins Single cell proteins production: substrates, factors effecting SCP production, composition, uses, economic parameters and constrains including safety aspects of SCPs with special reference to RNA content.	6
5.	Production of Organic Acids/Acidulants Raw materials, Starters and fermentation conditions, recovery and applications, Case studies production of acetic acid (vinegar), citric acid, lactic acid and gluconic acid Biocatalysts in Food processing.	5
6.	Sources of enzymes , advantages of microbial enzymes, mechanism of enzyme function, Production and purification of enzymes, immobilization and applications of biocatalysts in food processing, enzyme biosensors.	5
7.	Genetic Engineering and Genetically Modified Foods Genetic manipulation of microorganisms, Gene cloning procedures, vectors involved: plasmids, cosmids and phagemids, transfer of recombinant molecules into host organisms, Genetically Modified (GM) foods and their safety concerns.	5
8.	Treatment of Food Processing Wastes Food wastes (Whey, molasses, starch substrates and others), waste treatment technologies: aerobic and anaerobic methods of treatment of food industry wastes, bioremediation, Microbial production and importance of bio-surfactants, Microorganisms for bioenergy, bio-conversation of food wastes to useful products.	6
Total		42

Suggested Books:

S. No.	Authors/ Name of Books/Publisher	Year of Publication/Reprint
1.	Biotechnology P.K. Gupta	2008
2.	Biotechnology: Food Fermentation by V.K. Joshi	2009
3.	Enzymes in Food Processing by P.S. Panesar	2013
4.	Food Processing : Biotechnological Applications By S.S. Marwaha	2000