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PRINCIPAL & DEAN

AAU/FPTBE/PG Acad/ 410 /24
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Endorsement for the Programme Specific Outcomes, Programme Outcomes, and Course Outcomes Mapping of M. Tech. and Ph. D.-Food Technology curriculum

ICAR Fifth Deans' Committee has undertaken the task of formulating and advocating uniform courses, along with meticulously curated syllabi, across all esteemed colleges of food technology within our nation. The courses and syllabi have been structured with integral importance placed on precision and alignment with academic standards. They serve as a beacon of academic integrity and rigor, aimed at fostering a harmonized educational landscape within the realm of Food Technology. The recommendations set forth by the ICAR Fifth Deans' Committee have been duly endorsed and ratified, reflecting the discerning evaluation and unwavering commitment to educational excellence. This initiative has been executed with careful consideration of meticulous deliberations and diligent efforts by deans from various agricultural universities.

M. Tech. and Ph. D–Food Technology curriculumis herewith delineates and articulates for the Programme Specific Outcomes, Programme Outcomes, and Course Outcomes, meticulously and mapped to ensure a comprehensive and coherent educational framework. The undersigned hereby affix our official seal and endorsement, thereby granting unequivocal approval.


PRINCIPAL & DEAN

Course code	FQA 501	
Course title	Instrumental techniques in food analysis	
Course credit	3(1+2)	
Teaching per Week	5 hrs	
Course Objective (CO)	<ol style="list-style-type: none"> 1. To study the general criteria for food analysis 2. To understand the advanced instruments used and its application to food analysis 3. To understand the different chromatographic separation and analysis of food 4. To familiarize about rapid microbial analysis of food 5. To obtain knowledge of thermal techniques and microscopic techniques used in food analysis 6. To obtain theoretical and practical knowledge on modern analytical instruments used for Food analysis 	
Course Content	Unit 1	Introduction to Food Analysis: Introduction to food and its components, Sampling, Sample preservation, Extraction, Proximate analysis
	Unit 2	Spectroscopic Techniques: Introduction & theory of spectroscopic techniques, - Principle, Instrumentation, application of each technique. UV-Visible, IR, Raman, & Mass spectroscopy – Principle, Instrumentation, application of each technique. Fluorescence, Turbidoimetric techniques – Principle, Instrumentation, application of each technique. AAS – Principle, Instrumentation, applications. NMR/ESR spectroscopy – Principle, Instrumentation, application.
	Unit 3	Chromatographic Techniques: Introduction, HPLC, GC, Paper chromatography, TLC/HPTLC, Ion chromatography, Flash chromatography – Principle, Instrumentation, applications of each technique.
	Unit 4	Biological Techniques: Electrophoresis, PCR/RT-PCR, Immunoassays - Principle, Instrumentation, applications of each technique
	Unit 5	Recent Techniques: Rheology, DSC/DTA/TGA/TMA, XRD/XRF, Electron microscopy, Refractivity, Polarimetry - Principle, Instrumentation, applications of each technique
	PRACTICALS	
	Practical	Title
	1.	Determination of moisture by Karl Fischer method
	2.	Determination of carotenes (spectrophotometric)
	3.	Determination of Vitamin C (spectrophotometric)
	4.	Determination of gingerol by HPLC
	5.	Determination of minerals by AAS
	6.	Fatty acid profile in lipids by GC
	7.	Determination of Chloride content by Ion Chromatography
	8.	Determination of thermal properties using DSC
	9.	Determination of rancidity using Rancimat
	10.	Determination of sugar concentration and solids using Refractometer
	11.	Separation of amino acids using TLC/HPTLC
	12.	Separation of food colors using TLC/HPTLC

	13	Demonstration of PCR for Gene amplification					
	14	Agarose Gel Electrophoresis					
	15	Demonstration of ELISA test					
References:	1. Food Analysis: Theory and Practice, 1994. Y. Pomeranz and C.E. Meloan. 3 rd edn., Conn. (USA): AVI Publ. Co. 2. Stewart, K.K. and Whitaker, J.R. (1984). Modern Methods of Food Analysis. Conn: AVI Publ. Co. 3. James, CS. (1995). Analytical Chemistry of Foods. Blackie Academic and Professional, UK 4. Methods of analysis of food components and additives by Semih Otle, Published in 2005 by CRC Press.						
Course Outcomes	CO1: Expose to the important criteria and SOPs for food analysis CO2:. Understand the advanced instruments used and its application to food analysis CO3: Understand the different chromatographic separation and its analysis for food CO4: Acquire the knowledge about thermal and optical techniques used in food analysis CO5: Acquire theoretical and practical knowledge on modern analytical instruments used for food analysis						
Mapping between COs with PSOs	Mapping between COs and PSOs						
	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							
CO5							

Course code	FQA 504	
Course title	Advances in food chemistry and nutrition	
Course credit	3(2+1)	
Teaching per Week	4 hrs	
Course Objective (CO)	1. To study about importance and behaviour of water in food 2. To study about importance and behaviour of proteins in food 3. To study about importance and behaviour of lipids in food 4. To study about importance and behaviour of carbohydrates in food 5. To study about importance and behaviour of micronutrients in food	
Course Content	Unit 1	Physical and chemical properties of water: structure and chemical properties, solute effects on water, state of water in foods, kinetic principles; water activity: principles, measurement, control, effects, related concepts; acid-base chemistry of foods and common additives
	Unit 2	Proteins: physical properties of proteins in relation to protein structure, analytical methods; basic properties: hydration, ionization, colloidal behaviour; functional properties; effects of food processing: changes occurring in chemical, functional & nutritional properties of proteins; nitrite function, chemistry and nitrosamine formation. Protein as nutrient, protein quality, role in human body.
	Unit 3	Lipids: Content and role in foods, analytical methods, chemical, nutritional and physical properties, processing of fats and oils, degradation reactions
	Unit 4	Carbohydrates: simple sugars, sugar derivatives and oligosaccharides, basic chemistry, conformation, anomeric forms, equilibrium, reactivity, sweetness; sugar derivatives: sugar alcohols, glycosides, etc.; browning and related reactions; case studies – acrylamide and furan formation in foods; polysaccharides: basic structures and properties, starches, celluloses, gums, modification techniques; dietary fiber: components, properties, analysis. Nutritional importance.
	Unit 5	Vitamins: structure and properties of vitamins, distribution and morphology of vitamins in foods, changes of vitamins in food processing and storage, Regulation and control of vitamins in foods, relationship of vitamins and food quality. Deficiency of vitamins and metabolic disorders.
	Unit 6	Minerals: structure and properties of minerals, distribution and morphology of minerals in foods and processed goods, changes of minerals in food processing and storage, regulation and control of minerals in foods, relationship of minerals and food quality
	Unit 7	Role of protein, carbohydrate and lipid in nutrition, water, minerals and vitamins in nutrition: Functions, food sources, storage in body, deficiency, bioavailability etc.

	Unit 8	Effect of cooking and heat processing on nutritive value of food. Processed supplementary foods. Use of food in body: digestion, absorption transportation and utilization. Nutrition and its relation to obesity. Energy calculations form foods and formulation of balanced diet.						
	PRACTICALS							
	Practical	Title						
	1.	Estimation of moisture content in food sample						
	2.	Estimation of reducing sugars						
	3.	Estimation of crude fibre content						
	4.	Estimation of protein by Kjeldahl’s method						
	5.	Estimation of total ash, water soluble and acid soluble ash						
	6.	Extraction of fat						
	7.	Estimation of free fatty acids						
	8.	Estimation of peroxide value						
	9.	Estimation of iodine value						
	10.	Estimation of saponification value						
	11	Refractive index of fats and oils						
	12	Specific gravity of fats and oils						
	13	Water activity						
	14	Calculation of normal diet						
	15	Calculation of liquid diet						
16	Calculation of high and low calorie diet							
References:	1. Fennema's Food Chemistry, Fourth Edition (Food Science and Technology) Srinivasan Damodaran, Kirk L. Parkin, Owen R. Fennema. 2. Belitz, H. D. and Grosch, W. Food Chemistry. Second Edition. New Yolk: Springer verlag, Berlin Heidelberg, 1999. 3. Medeiros, D., & Wildman, R. (2011). Advanced Human Nutrition: Jones & Bartlett Learning.							
Course Outcomes	CO1: Sound understanding of importance and behaviour of water in food CO2: Sound understanding of importance and behaviour of proteins in food CO3: Sound understanding of importance and behaviour of lipids in food CO4: Sound understanding of importance and behaviour of carbohydrates in food CO5: Sound understanding of importance and behaviour of micronutrients in food							
Mapping between COs with PSOs	Mapping between COs and PSOs							
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							

Course code	FQA 509	
Course title	Advances in food additives and preservatives	
Course credit	3(2+1)	
Teaching per Week	4 hrs	
Course Objective (CO)	1. To study various classes of food additives 2. To familiarise about working principles of food additives	
Course Content	Unit 1	Introduction- what are food additives, role of food additives in food processing , functions, classification, intentional and unintentional food additives, toxicology and safety evaluation of food additives, beneficial effects of food additives/toxic effects, food additives generally recognized as safe (GRAS), tolerance levels and toxic levels in foods-LD 50 values of food additives
	Unit 2	Naturally occurring food additives, classification, role in food processing, health implications, food colors, natural and synthetic food colors, types , their chemical nature and their impact on health
	Unit 3	Preservatives, what are preservatives, natural preservation, chemical preservatives, their chemical action on foods and human system, Antioxidants and chelating agents, their role in foods, types of antioxidants – natural and synthetic, chelating agents, their mode of action in foods with examples
	Unit 4	Surface active agents, their mode of action in foods with examples, stabilizers and thickeners with examples and their role in food processing, bleaching and maturing agents, examples of bleaching agents, what is maturing, examples of maturing agents and their role in food processing
	Unit 5	Starch modifiers, chemical nature, their role in food processing, buffers- acids and alkalis, examples, types, their role in food processing, Sweeteners, what are artificial sweeteners and non nutritive sweeteners, their health implications, role in food processing
	Unit 6	Flavoring agents, natural and synthetic flavors, examples and their chemical nature, role of flavoring agents in food processing, Anti-caking agents, their role in food processing, Humectants- definition, their role in food processing
	Unit 7	Clarifying agents- definition, examples, their role in food processing
	PRACTICALS	
	Practical	Title
	1.	Determination of benzoic acid in food samples
	2.	Estimation of sulphur dioxide in food samples
	3.	Estimation of sorbic acid in cheese and yoghurt
	4.	Determination of nitrate and nitrites in foods
	5.	Detection and determination of aspartame by thin layer chromatography
	6.	Liquid chromatographic determination of caffeine, benzoate and saccharin in soda beverage

	7.	Identification of natural colours						
	8.	Isolation, identification and estimation of synthetic food colours						
	9.	TLC detection of antioxidants in fats and oils						
	10.	TLC detection of emulsifiers						
	11	Detection of alginates in foods (chocolate, ice cream)						
	12	GC determination of menthol in mentholated pan masala						
References:	1. Baren, A. F. et al (2001). Food additives, 2 nd edition, Marcel Dekker. 2. George, A. B. (1991). Encyclopaedia of food and colour additives, Vol III, CRC Press. 3. Nakai, S. and Modler, H. W. (2000). Food proteins: processing applications, Wiley							
Course Outcomes	CO1: Knowledge about various classes of food additives CO2: Understanding about working principles of food additives							
Mapping between COs with PSOs	Mapping between COs and PSOs							
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							

Course code	FQA 511	
Course title	Advances in fermentation technology	
Corse credit	4(2+2)	
Teaching per Week	6 hrs	
Course Objective (CO)	<ol style="list-style-type: none">1. To learn significance of microorganisms in fermentation and fermentation of foods and food products.2. To learn the sources, growth characteristics, metabolism of microorganisms associated to fermented foods and food products.3. To understand the role of starter cultures in industrial production of fermented food and food products.4. To gain knowledge on the methods of isolating and characterizing microbes associated with fermented foods.5. To understand the processing methods for the production of well-known fermented foods.	
COURSE CONTENT	Unit 1	Introduction: Fermentation- historical development; fermented food products of India; worldwide fermented food products; classification of fermented food products.
	Unit 2	Fermentation- Basic Concepts: Basic principles involved in fermentation; types of fermentation; starter culture; preparation and maintenance of bacterial, yeast and mold cultures for food fermentations.
	Unit 3	Fermented Milk Products: Processing, manufacture, storage and packaging of acidophilus milk, cultured butter-milk and other fermented milk; bio-chemical changes occurring during manufacture of fermented milks; factors affecting these changes and effects of these changes on the quality of finished products.
	Unit 4	Fermented Vegetables Products: Technological aspects of pickled vegetables, sauerkraut, cucumbers; mushrooms-cultivation and preservation
	Unit 5	Fermented cereal and Pulse Products: Fermented soy sauce; microbiology and biochemistry; soy sauce manufacturing methods; miso fermentation- raw materials and microorganism for fermentation; comparison of Indigenous and modern processing; spoilage microbes; tempeh- production and consumption, raw material used, essential steps of fermentation; indigenous fermented product- idli, dosa, dhokla etc.
	Unit 6	Fermented Fish and Meats Product: Fermented fish and fish products- fish sauces, fermented fish pastes; fermented sausages-process for manufacture of fermented sausage biochemical and microbiological changes during sausage ripening.
	Unit 7	Alcoholic Fermentation Products: Technology for processing oh wine, cider, beer etc.; microbiological and biochemical aspects

	Unit 8	Other Fermented Products: Methods of manufacture for acetic acid/vinegar, baker’s yeast, microbial protein, lactic acid etc. Traditional fermented Foods of India: Dahi, lassi, Butter Milk, Jalebi, Khaman, Dhokla, Idli, Wada etc. Future of Fermented Foods: Advances in microbiology, role of intestinal bacteria in human health in future, regulation and health claims for fermented foods.						
	List of Practical:							
	1	Preparation of fermented cereal products						
	2	Preparation of fermented pickles						
	3	Preparation of Dahi and Lassi						
	4	Freeze drying of starter culture						
	5	Preparation of Cheese and analysis						
	6	Preparation of yoghurt						
	7	Study of bacteriophages in starter culture						
	8	Preparation of Traditional fermented food of India						
	9	Preparation of Tempeh						
	10	Preparation of alcoholic products						
	11	Study of Probiotic bacteria						
	12	Preparation of symbiotic food						
	13	Industrial Visits						
References:	1. Microbiology of fermented foods by B. J. B. Wood, Springer 2. Microbiology and Technology of Fermented Foods by Robert W. Hutkins, IFT Press 3. Handbook of Indigenous Fermented Foods by K. H. Steinkrauss, CRC Press 4. Outlines of Dairy Technology by Sukumar De, Oxford University Press							
Course Outcomes	On completion of course students will be able to: CO1. Understand about the fermentation and role of microorganism in fermentation and its application and industrial production of fermented foods. CO2. Gain the knowledge about the starter cultures and microorganism that are responsible for the fermentation of food and food products. CO3. Learns the selection and use of microorganisms for production of desirable fermented foods and food products. CO4. Understand about the various types of fermented foods that are popular throughout the world and production and processing of these fermented foods. CO5. Understand the different tests and procedure for the characterization and application of starter culture and probiotic microorganisms for the fermented foods production suitability.							
Mapping between COs with PSOs	Mapping between COs and PSOs							
		PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
	CO1							
	CO2							
	CO3							
	CO4							
	CO5							

Course code	FQA 512	
Course title	Advances in food microbiology	
Corse credit	3(2+1)	
Teaching per Week	4 hrs	
Course Objective (CO)	<ol style="list-style-type: none">1. To learn advances in microorganisms associated to food and food products.2. To learn the sources, growth characteristics, metabolism of microorganisms.3. To understand the recent techniques and role of microbes in spoilage and pathogenesis.4. To gain knowledge on the methods of isolating and characterizing microbes associated with foods5. To understand the methods used to detect pathogens in foods.	
COURSE CONTENT	UNIT 1	History, scope and importance of food microbiology
	UNIT 2	Microorganisms and food: Their primary sources of microorganisms in foods: Airborne bacteria and fungi, Microorganisms found in soil, Microorganisms in water, Normal flora of skin, nose, throat, GI tract.
	UNIT 3	Factors affecting the survival and growth of microorganisms in food: Intrinsic factors for growth, Moisture, pH & acidity, Nutrient content, Biological structure, Redox Potential, Naturally occurring and added antimicrobials, Competitive micro flora, Extrinsic factors for growth, Types of packaging/atmospheres, Effect of time/temperature conditions on microbial growth, Storage/holding conditions, Processing steps.
	UNIT 4	Microbiological examination- Methods of Isolation and detection of microorganisms or their products in food. - Conventional methods - Rapid methods (Newer techniques) – Immunological methods: Fluorescent, antibody, Radio immunoassay, ELISA etc. - Chemical methods PCR (Polymers chain reactions), RT PCR, Microchip based techniques
	UNIT 5	Microflora of Fresh Food: Meat, Poultry, Eggs, Fruits and vegetable, Shellfish and Finish, Milk, Microbial Spoilage of Food, Fresh Foods, Fresh Milk, Canned Foods
	UNIT 6	Food Preservation and application to different types of foods: Physical methods –, Drying, freeze drying cold storage, heat treatments(pasteurization), TDT, TDP, Irradiation (UV, microwave, ionization), high pressure processing, Aseptic packaging, modified atmosphere, Chemical preservatives and Natural antimicrobial compounds. Biologically based preservation systems

	UNIT 7	Food borne infections and diseases: Significance to public health Food hazards and risk factors, Bacterial, and viral food-borne disorders, Food-borne important animal parasites, Mycotoxins. - Bacillus, Campylobacter, Brucella, Staphylococcus, Clostridium, <i>E.coli</i> , Aeromonas, <i>Vibrio cholerae</i> , Listeria, Mycobacterium, Salmonella, Shigella
	UNIT 8	Quality Control/Quality Assurance Legislation for food safety – national and international Criteria, sampling schemes, records, risk analysis QC- microbial source, code Indicators of food safety and quality: Microbiological criteria of foods and their significance.
	UNIT 9	The HACCP system and food safety used in controlling microbiological hazards.
	List of Practical:	
	1	Preparation of common laboratory media and special media for cultivation of bacteria, yeast & molds.
	2	Staining of Bacteria: Gram's staining, acid-fast, spore, capsule, Motility of bacteria, Staining of yeast and molds.
	3	Isolation of microorganisms: Different methods and maintenance of cultures of microorganisms.
	4	Bacteriological analysis of Foods using conventional methods.
	5	Coli forms analysis of milk and water samples.
	6	To perform various biochemical tests used in identification of commonly found bacteria in foods: IMVIC urease, H ₂ S, Catalase, coagulase, gelatin and fermentation (Acid/gas).
References:	7	Determination of thermal death characteristics of bacteria.
	8	Demonstration of available rapid methods and diagnostic kits used in identification of microorganisms or their products.
	9	Visits (at least two) to food processing unit or any other organization dealing with advanced methods in food microbiology.
	1. Pelzer, M.I. and Reid, R.D. (1993) Microbiology McGraw Hill Book Company, New York, 5 th Edition.	
	2. Atlas, M. Ronald (1995) Principles of Microbiology, 1 st Edition, Mosby-Year Book, Inc, Missouri, U.S.A.	
	3. Topley and Wilson's (1983) Principles of Bacteriology, Virology and Immunity, Edited by S.G. Wilson, A. Miles and M.T. Parkar, Vol. I: General Microbiology and Immunity, II: Systematic Bacteriology. 7 th Edition. Edward Arnold Publisher.	
	4. Frazier, W.C. (1988) Food Microbiology, McGraw Hill Inc. 4 th Edition,	
	5. Jay, James, M. (2000) Modern Food Microbiology, 6 th Edition. Aspen publishers, Inc., Maryland.	
	6. Banwart, G. (1989) Basic Food Microbiology, 2 nd Edition. CBS Publisher.	
	7. Doyle, P. Benehat, L.R. and Mantville, T.J. (1997): Food Microbiology, Fundamentals and Frontiers, ASM Press, Washington DC.	
Course	8. Adams, M.R and M.G. Moss (1995): Food Microbiology, 1st Edition, New Age International (P) Ltd.	
	On completion of course students will be able to:	

Course code	FQA516		
Course title	Advances in food biotechnology		
Corse credit	3(2+1)		
Teaching per Week	4 hrs		
Course Objective (CO)	1 To learn basic aspects of fermentation process 2 To learn application of enzymes and its production 3 To learn production of different products through fermentation 4 To learn different techniques used in food biotechnology 5 To learn biotechnological aspects for the production of functional food		
Course Content	Unit 1	History of biotechnology, status of biotechnology in India, primary and secondary screening, introduction to primary and secondary metabolites. Introduction to control of metabolic pathways. Techniques for isolation and screening of microorganisms.	
	Unit 2	Strain improvement, fermentation process of enzyme, fermentation processes of alcohol and organic acids, fermentation processes of antibiotics.	
	Unit 3	Food applications of enzymes; amylases, proteases, lipase, pectinase, celluloses, glucose oxidase. Microencapsulation of enzyme/probiotics.	
	Unit 4	Genetic improvement of starter cultures to improve technological features of starter cultures such as acid, flavor, EPS production etc.	
	Unit 5	Recombinant DNA technology for production of protease, lipase, chimosin, immunoglobulins etc.	
	Unit 6	Functional and nutraceuticals, supplementation/fortification of bioactive peptides and other functional ingredients, nutrigenomics.	
	Unit 7	Application of molecular tools, biosensors etc. for the detection of pathogens.	
	Unit 8	Molecular tools for study of biodiversity. Regulatory standards for GMO and GM foods.	
List of practical: <ul style="list-style-type: none">• Demonstration of fermenter• To carry out fermentation of amylase enzyme• Introduction to enzyme purification techniques• To carry out quantitative estimation of amylase• To carry out enzyme assay of invertase• Demonstration of enzyme immobilization• Determination of stability of enzyme at different temperature, pH• Extraction and clarification of juices using enzymes• Introduction to microbial isolation techniques• Detection of food borne pathogen by conventional microbiological method• Microencapsulation of probiotics and study of their viability• Isolation of genomic DNA			

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