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COLLEGE OF FOOD PROCESSING TECHNOLOGY & BIO ENERGY (AAU)
Anand – 388110, Gujarat, India

DR. SAMIT DUTTA
PRINCIPAL & DEAN

AAU/FPTBE/PG Acad/ 411 /24
Dated: 30 / 05 /2024

Endorsement for the Programme Specific Outcomes, Programme Outcomes, and Course Outcomes Mapping of M. Tech. and Ph. D.- Food Technology curriculum

ICAR appointed National Core Group and BSMA Committees for revision and restructuring of Post-graduate and Doctoral syllabi in **M. Tech. and Ph. D.- Food Technology** 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 curriculumas per the BSMA recommendations is 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	**FSQ 501**
Course title	**Techniques in food quality analysis**
Corse credit	**4 (2+2)**
Teaching per Week	**6 hrs**
Course Objective (CO)	1. To understand use of spectroscopy in food analysis 2. To obtain knowledge of different separation techniques for isolation and separation of compounds 3. To obtain knowledge of chromatographic techniques used in food quality analysis 4. To obtain knowledge of thermal techniques used in analysis of food 5. To obtain knowledge of sampling and microbial analysis in food
Course Content	**Theory** **UNIT I** Sampling Procedures, Calibration and Standardization: Sub- sampling and its procedures, LOD, LOQ, Internal standards, Reference standards and certified reference materials. Spectroscopy techniques: Operation, calibration and standardization procedures as applicable to particular technique. Principles and applications of pH Meter, Digital analyzer, Auto-analyzer, Ultraviolet- visible spectroscopy (UV-VIS), Infra-Red, Fourier-Transform Infrared Spectroscopy (FTIR), Near Infra-Red (NIR), Atomic Absorption spectroscopy (AAS). **UNIT II** Chromatography Techniques: Principles, Components and applications of (i) Paper Chromatography- Ascending and Descending-One dimensional & Two-dimensional (ii) Thin layer chromatography (iii) Ion Exchange (iv) GC (v) GLC (vi) HPLC (vii) HPTLC (viii) GCMS (ix) LCMS (x) Amino acid Analyzer **UNIT III** Separation Techniques: Dialysis, Gel filtration, Electrophoresis: Principles, components and applications of (i) Paper (ii) Starch (iii) Gel (iv) Agar-gel (v) Polyacrylamide gel (vi) Moving boundary (vii) Immuno electrophoresis. Centrifugation: Types of centrifuge – Ordinary and Ultracentrifuge- Principle and applications. **UNIT IV** Principle, Components and Applications of (i) Differential scanning calorimetry (DSC) (ii) Thermogravimetric analysis (TGA) (iii) Isothermal microcalorimetry (IMC) (iv) Thermomechanical analysis (TMA) (v) Isothermal titration caloritmetry (ITC) (vi) Dynamic elemental thermal analysis (DETA) (vii) Nuclear magnetic resonance (NMR) (viii) Scanning electron microscopy (SEM) (ix) Transmission electron microscopy (TEM) (x) X-ray diffraction technique (XRD) (xi) Rapid visco-analyzer (xii) Texture analyzer and (xiii) Micro-dough lab. **UNIT V** Sampling for microbial analysis, Quantitative methods for enumeration of microorganisms in foods, Methods for isolation of microorganisms in foods, Rapid detection of microorganisms using molecular biological tools, immunoassays and biosensors. **List of practical:** • Analysis and characterization of pigment in fruits by UV-VIS.

<table>
<tr><td></td><td>
• Characterization of starches by FTIR spectroscopy.
• Assessment of microstructure of food components by SEM/Reviewing a micrograph obtained through SEM
• Study of thermal denaturation of proteins and food enzymes by DSC.
• Quantization of allergenic proteins by LCMS.
• Separate and identification of pesticides in food samples by HPLC.
• Identification and molecular characterization of proteins by SDS-PAGE.
• Quantization of lipids and fatty acids using TLC.
• Assessment of pasting properties of starches and flours/flour-blends using RVA.
• Analysis of textural properties of food products with texture analyzer.
• Comparative rheological study of wheat flour samples of different varieties.
• Differential thermal analysis (DTA) and Thermogravimatric Analysis of a food samples
• A rapid, visual demonstration of protein separation by gel filtration chromatography.
• Amino acid profiling of food samples
• Detection of food borne pathogens using RT-PCR
• Rapid detection of microorganisms using ELISA
</td></tr>
<tr><td>References:</td><td>

1. Ongkowijoyo P, Luna-Vital DA, de Mejia EG (2018) Extraction techniques and analysis of anthocyanins from food sources by mass spectrometry: An update Food chemistry.
2. Trimigno A, Marincola FC, Dellarosa N, Picone G, Laghi L (2015) Definition of food quality by NMR-based foodomics, Current Opinion in Food Science 4:99-104.
3. Pare, J. R. J. and Bélanger, J. M. R. (2015). Instrumental Methods of Food Analysis: Elsevier.
4. Alejandro Cifuentes (2012) Food Analysis: Present, Future, and Foodomics, ISRN Analytical Chemistry.
5. Skoog, D. A., Holler, F. J. and Nieman, T. A. (1998). Principles of Instrumental Analysis (5 Ed.): Harcourt, Singapore.

</td></tr>
<tr><td>Course Outcomes</td><td>
On completion of the course students will be able to
CO1. Use spectroscopic techniques in analysis of food
CO2. Use different separation techniques for isolation and separation of compounds
CO3. Use chromatographic techniques for food quality analysis
CO4. Use thermal techniques in analysis of food
CO5. Carry out microbial analysis of food
</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>
Mapping between COs and PSOs
<table>
<tr><th></th><th>PSO1</th><th>PSO2</th><th>PSO3</th><th>PSO4</th><th>PSO5</th><th>PSO6</th><th>PSO7</th></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<table>
<tr><td>Course code</td><td>FSQ 502</td></tr>
<tr><td>Course title</td><td>Microbiology of food spoilage and pathogens</td></tr>
<tr><td>Corse credit</td><td>3(2+1)</td></tr>
<tr><td>Teaching per Week</td><td>4 hrs</td></tr>
<tr><td>Course Objective (CO)</td><td>1. To learn about the microorganisms associated with food spoilage and food borne outbreak.
2. To learn the sources of microorganism, their growth characteristics, factors affecting growth of microorganisms in food and food products and metabolism of microorganisms.
3. To understand the different types of food spoilages caused by the microorganisms and processing for the control of food spoilage.
4. To understand about the food borne pathogens and their role in food borne outbreak.
5. To gain knowledge on the methods of isolating and characterizing and enumerations of spoilage causing microbes and food pathogens.</td></tr>
<tr><td>COURSE CONTENT</td><td>
<table>
<tr><td>UNIT 1</td><td>Food Borne Pathogens, Host Invasion, Pathogenesis, Significance to public health Food hazards and risk factors, Pathogenic foodborne microorganisms – Salmonella, Pathogenic Escherichia coli and other Enterobacteriaceae, Staphylococcus aureus, Listeria monocytogenes, Clostridium botulinum, Clostridium perfringens and Bacillus cereus Other Gram-positive pathogens, Campylobacter, Brucella, Aeromonas, Vibrio cholerae, Mycobacterium, Shigella.</td></tr>
<tr><td>UNIT 2</td><td>Fungal and viral food-borne disorders, Food-borne important animal parasites, Mycotoxins, Incidence and behavior of microorganisms in meat, poultry, milk and milk products, fresh agro produce, sea foods.</td></tr>
<tr><td>UNIT 3</td><td>Controlling pathogens and microbial toxin via food processing, Microbial growth and shelf life, Modeling of microbial growth, Safety concerns of food processed through non thermal processing, management of microbial risk and toxin in foods through HACCP, Risk in antimicrobial nano materials, Risk assessment and predictive modeling</td></tr>
<tr><td>UNIT 4</td><td>Molecular approaches for detection and identification of food borne pathogens, Enzyme Immunoassay (EIA), Enzyme-linked immunosorbent assay (ELISA), Radioimmunoassay (RIA) - instrumentation and applications of each immunoassay technique. DNA: DNA purification, DNA Fingerprinting. PCR/RTPCR (Real time) based analysis and sequencing, Biosensors, Recombinant DNA technology; Microchip based techniques, cDNA and genomic libraries, immunochemical techniques.</td></tr>
<tr><td>UNIT 5</td><td>Important factors in microbial food spoilage, Spoilage of specific food groups, New food spoilage bacteria in refrigerated foods, Indicators of microbial food spoilage.</td></tr>
</table>
<table>
<tr><td colspan="2">List of Practical:</td></tr>
<tr><td>1</td><td>Preparation of common laboratory media and special media for cultivation of bacteria, yeast & molds.</td></tr>
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	2	Isolation and identification of pathogens.
	3	Coliforms analysis of milk and water samples.
	4	Identification tests for bacteria in foods: IMVIC urease, catalase, coagulase, gelatin and fermentation (acid/gas).
	5	Determination of thermal death characteristics of bacteria.
	6	Determination of DNA and RNA of spoilage microorganism using PCR.
	7	Detection of DNA of trace components allergens, like nuts using ELISA.
	8	DNA/RNA based microarray experiment.
	9	DNA/RNA based microarray experiment.
	10	Determination of growth and activity of microorganisms in incubator.
	11	Determination of preservatives and food colours using Biosensor.
	12	Process time calculation for an indicator organism
	13	Microbes responsible recall – case studies.

References:

1.Ray, B., and A. Bhunia. 2007. Fundamental Food Microbiology, 4th Ed. CRC Press, Boca Ratan, FL.

2.Food and Drug Administration. Food-Borne Pathogenic Microorganisms and Natural Toxins Handbook: The Bad Bug Book.

3.Fratamico PM, Bhunia AK & Smith JL. 2005. Food -Borne Pathogens: Microbiology and Molecular Biology. Caister Academic Press.

4.Vijay K. Juneja, Hari P. Dwivedi, John N. Sofos Editors, 2017, Microbial Control and Food Preservation - Theory and Practice, Springer

5.Ronald H. Schmidt and Gary E. Rodrick 2013 Food Safety Handbook Wiley

Course Outcomes

On completion of course students will be able to:

CO1. Understand about roles played by microorganisms in food spoilage and food borne outbreaks.

CO2. Understand the sources of microorganism, their growth characteristics, factors that affect growth of microorganisms in food and food products and metabolism of microorganisms.

CO3. Understand the various types of food spoilages caused by the microorganisms and processing of food and food products for the control of food spoilage.

CO4. Understand about the food borne pathogens and their role in food borne outbreak.

CO5. Able to use standard protocols for the enumeration of spoilage causing microorganism as well as the methods of isolating and characterizing microorganisms associated to food spoilage and food borne outbreaks.

Mapping between COs with PSOs

Mapping between COs and PSOs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■				■	■	
CO2	■		■	■	■		
CO3	■				■		
CO4	■				■		
CO5	■	■	■	■	■		■

<table>
<tr><td>Course code</td><td colspan="2">FSQ 503</td></tr>
<tr><td>Course title</td><td colspan="2">Advanced food chemistry</td></tr>
<tr><td>Corse credit</td><td colspan="2">3(2+1)</td></tr>
<tr><td>Teaching per Week</td><td colspan="2">4 hrs</td></tr>
<tr><td>Course Objective (CO)</td><td colspan="2">1. To study composition, nutritional and function value of food
2. To study structure and properties of proteins
3. To learn about food flavours
4. To familiarize about food contaminants</td></tr>
<tr><td>Course Content</td><td colspan="2">
<table>
<tr><td>Unit 1</td><td>Composition, nutritional and functional value of food: Water activity and sorption phenomenon, Engineered foods and influencing water activity and shelf-life; Chemical reactions of carbohydrates– oxidation, reduction, with acid & alkali; Maillard reaction, Caramelization, Ascorbic acid oxidation, Resistant Starch, Soluble and Insoluble fibre, Pigments and approaches to minimize the impact of food processing, Molecular Mobility.</td></tr>
<tr><td>Unit 2</td><td>Structure and Properties of proteins; electrophoresis, sedimentation, amphoterism, denaturation, viscosity, gelation, texturization, emulsification, foaming, protein-protein and other interactions in food matrix; Lipids: melting point, softening point, smoke, flash and fire point, turbidity point, polymorphism and polytypism; polymerization and polymorphism, flavor reversion, auto- oxidation and its prevention, fat in food matrix like fat globule in milk, PUFA, MUFA, CLA, ù - fatty acids, trans fatty acids, phytosterol, etc.</td></tr>
<tr><td>Unit 3</td><td>Description of food flavours; Flavour enhancers, Food acids their tastes and flavours, Principles and techniques of flavour encapsulation, types of encapsulation; Factors affecting stabilization of encapsulated flavour and their applications in food industry.</td></tr>
<tr><td>Unit 4</td><td>Processing and packaging induced chemicals and their control – acrylamide, nitrosamines, carcinogenic and genotoxic chloropropanols such as 3-monochloropropane-1,2 diol (3-MCPD), PAHs (in grilled and smoked products), dioxine, histamine, ethyl carbamate, furan, bisphenol A or phthalates from plastic materials, microplastics, 4-methylbenzophenone and 2-isopropylthioxanthone from inks, mineral oil from recycled fibers or semicarbazide from a foaming agent in the plastic gasket.</td></tr>
</table>
List of practical:
<table>
<tr><td>Sr. No.</td><td>Title</td></tr>
<tr><td>1.</td><td>Estimation of protein content in food samples using spectroscopic methods</td></tr>
<tr><td>2.</td><td>Study of effect of heat on protein denaturation using enzymes</td></tr>
<tr><td>3.</td><td>Study of effect of various salt solutions on solubility of proteins</td></tr>
<tr><td>4.</td><td>Separation of milk proteins by salting out method</td></tr>
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	5. Separation of proteins using chromatographic methods 6. Fractionation of proteins 7. Extraction and purification of essential oil/ flavoring compound of a natural source 8. Study the process of starch retrogradation, gelatinization and modification 9. Estimation of crude and dietary fibres in given food sample 10. Analysis of resistant starches 11 Estimation of various antioxidants, polar compounds and free fatty acids in frying oils 12 Extraction and purification of natural plant pigment 13 Functional properties and isoelectric point of proteins 14 Qualitative and quantitative evaluation of processing and packaging induced chemicals 15 Qualitative identification of different flavoring compounds
References:	1. O.R. Fennema, Ed., (2008). Food Chemistry, Marcel and Dekker, Inc., New York, NY. 2. Belitz, H. D., Grosch,W., & Schieberle, P. (2009). Food chemistry. Springer. 3. Peter Varelis, Laurence Melton and Fereidoon Shahidi (2019). Encyclopedia of Food Chemistry. Elsevier. 4. Cheung, Peter C. K., Mehta, Bhavbhuti M. (2015) Handbook of Food Chemistry. Springer.
Course Outcomes	CO1: Gain the knowledge of composition, nutritional and function value of food CO2: Insights about structure and properties of proteins CO3: Gain the knowledge about flavours understanding CO4: Knowledge about food contaminants
Mapping between COs with PSOs	**Mapping between COs and PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							

Course code	**FSQ 504**	
Course title	**Global Food Laws and Regulations**	
Corse credit	**2 (2+0)**	
Teaching per Week	**2 h**	
Course Objective (CO)	1. To acquire knowledge of basic concepts of different organisations involved in development of food laws 2. To get acquainted with European and US Food Laws 3. Familiarize with HACCP and its concept and application in food industry 4. Familiarize with Indian Food Laws	
Course Content	**Unit 1**	International Plant Protection Convention, world organization for animal health (OIE), sanitary and phytosanitary measures (SPS), Codex Alimentarius, FAOLEX, OECD Agriculture and Fisheries, International Trade Centre's Standards Map, FAO Food safety and quality emergency Prevention, JFSCA, Fundamental Principles of food safety governance, Risk Analysis as a Method to Determine the Regulatory Outcome, Increasing Responsibility of Businesses (Private) Risk Assessors, Concept of harmonization ofglobal food laws,
	Unit 2	EU Food Safety Standards - Regulation 178 of 2002, The European food safety authority (EFSA), A critical overview of the EU food safety policy and standards, COMESA Food Safety Standards - An overview, Case Studies in Food Safety Standards in EU-COMESA Trade, Private voluntary standards (PVS) and EU food safety standards, FDA Food safety modernization Act (FSMA), FSPCA Preventive Controls for Human Food, Foreign Supplier Ve rification Programs (FSVP), Food Facility Registration, FDA - Current Good Manufacturing Practices (CGMPs)
	Unit 3	Hazard Analysis & Critical Control Points (HACCP) guidelines, Foreign Food Facility Inspection Program, International and Interagency Coordination, Registration of Food Facilities, Seafood Imports and Exports, Regulation on GM Foods Regulations on Irradiated foods, Global Regulations on Health Foods, International Law on Adequacy of thermal processing, Grain Fumigation for Export, Law of trading horticultural Products, Safety Frame Applied to Food Applications of Nanotechnology.
	Unit 4	Review of Indian Regulatory Scenario in Food and Food

	Products - Food Safety and Standards (FSS) Act, 2006, FSS Rules and Regulations, Agricultural Produce Act, 1937 (Grading and Marketing), Export (Quality Control & Inspection), Act, 1963 and Rules, Bureau of Indian Standards relevant to fod safety, Legal Metrology Act, International Food Control Systems/ Laws.
References:	1. Onsando Osiemo, 2018, Food Safety Standards in International Trade: The Case of the EU and theCOMESA, CRC 2. Andrea Barrios Villarreal, 2018, International Standardization and the Agreement on Technical Barriersto Trade, Cambridge University Press 3. Bernd Meulen, Harry Bremmers, Kai Purnhagen, Nidhi Gupta, Hans Bouwmeester L. and Leon Geyer, 2014, Governing Nano Foods: Principles-Based Responsive Regulation 4. Understanding the Codex Alimentarius, 3rd ed., 2006. 5. JessicaVapnek and Melvin Spreij, 2005, Perspectives and guidelines on food legislation, with a newmodel food law for the Development Law Service FAO Legal Office 6. US FDA Website 7. European Food Safety Authority (EFSA) website
Course Outcomes	CO1: Able to elaborate the organisation involved in development of global food laws CO2: Able to apply HAACP in food industry CO3: Able to do registration for foreign food inspection program of US CO4: Able to use knowledge of Indian food laws in industry
Mapping between COs with PSOs	**Mapping between COs and PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1							
CO2							
CO3							
CO4							

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<tr><td>Course code</td><td colspan="2">FSQ 507</td></tr>
<tr><td>Course title</td><td colspan="2">Quality concepts and chain traceability</td></tr>
<tr><td>Corse credit</td><td colspan="2">2(2+0)</td></tr>
<tr><td>Teaching per Week</td><td colspan="2">2 hrs</td></tr>
<tr><td>Course Objective (CO)</td><td colspan="2">1. To understand various quality concepts
2. Familiarization with use of various QC tools</td></tr>
<tr><td>Course Content</td><td>Unit 1</td><td>Quality – Concepts, Quality as winning strategy, Total quality management TQM: Introduction, definitions and principles of operation, Tools and Techniques, such as, quality circles, 5 S Practice, Total quality control (TQC), Total employee involvement (TEI), Problem solving process, Quality function deployment (QFD), Failure mode and effect analysis (FMEA), Fault Tree Analysis (FTA), Kaizen, Poka- Yoke, QC Tools, PDCA Cycle, Quality Improvement Tools, TQM implementation and limitations, JH – Autonomous maintenance</td></tr>
<tr><td></td><td>Unit 2</td><td>Introduction, Content, Methods, Advantages and Limitation of: Just –in –Time and Quality Management KANBAN system, Total productive maintenance (TPM), QS 9000. Basic concept, Principle, methodology of contemporary trends: Lean manufacturing, Agile manufacturing, World class manufacturing, Concurrent engineering, Bench marking, Cost of quality (COQ) system.</td></tr>
<tr><td></td><td>Unit 3</td><td>Reliability engineering fundamentals; Failure data analysis; Failure rate; mortality curve; Concept of burn in period; Useful life and wear out phase of a system; Mean time to failure (MTTF); Mean time between failure, (MTBF) and mean time to repair (MTTR); Reliability in terms of Hazard rate and failure density, Measurement systems analysis for accuracy, Probability for quality.</td></tr>
<tr><td></td><td>Unit 4</td><td>SQC -Statistical quality control– X / R / p and c chart, Shewhart and types of control charts, Process capability analysis, process capability index. Acceptance sampling by variables and attributes, design of sampling plans, single, double, sequential and continuous sampling plans, design of various sampling plans for food industry (Note: SQC tables can be used in the examination), Capability analysis. Statistical process control.</td></tr>
<tr><td></td><td>Unit 5</td><td>Traceability in food safety management, Applications of traceability, Traceability challenges, Traceability requirements and standards: ISO 22005, Traceability implementation & application: Traceability data & process flow, Traceability process participants, Traceable item, Batch/Lot and Traceability links management, Food authenticity tools.</td></tr>
<tr><td>References:</td><td colspan="2">1. Montgomery, Jennings and Pfund, 2010, Managing, Controlling and Improving Quality, Wiley
2. K C Arora, 2016 (4th Edition), Total Quality Management, S K Kataria & Sons Pub
3. Eugene L. Grant and Richard S. Leavenworth,7th Ed 1996, Statistical Quality Control, McGraw- Hill</td></tr>
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<table>
<tr><td>Course Outcomes</td><td>CO1: Good understanding about various quality concepts
CO2: Knowledge about use of various QC tools</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>Mapping between COs and PSOs
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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Course code	**FSQ 512**
Course title	**Advances in food biotechnology**
Corse credit	**4(2+2)**
Teaching per Week	**6 h**
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 for the production of functional food
Course Content	**Theory** UNIT I 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, Strain improvement, techniques. UNIT II Introduction to enzyme, Characteristics of enzyme, Food applications of enzymes; amylases, proteases, lipase, pectinase, celluloses, glucose oxidase. Microencapsulation of enzyme/probiotics. UNIT III Fermentation processes, fermentation processes of: alcohol and organic acids, Amylases, protease, lipase, bacteriocins, UNIT IV Functional and nutraceuticals, supplementation/fortification of bioactive peptides and other functional ingredients, nutrigenomics. UNIT V Application of molecular tools, PCR, RT-PCR, biosensors etc. for the detection of pathogens. **List of practical:** • 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 • Agarose gel electrophoresis • DNA amplification by using PCR • RT PCR for pathogen detection

<table>
<tr><td></td><td>• Gene cloning</td></tr>
<tr><td>References:</td><td>1. Principles of Fermentation Technology by Stanbury and Whittaker: 2nd Edition
2. Industrial Microbiology: L.E.Casida,Willey Eastern Ltd., 1989.
3. Bioprocess Engineering–Basic concepts by M. L. Schuler & F. Kargi, Entice Hall; 1992.
4. Biotechnology-a hand book of industrial microbiology: W. Crueger and A. Crueger.
5. Basic Biotechnology by Colin Ratledge and Bjorn Kristiansen: 2nd Edition, Cambridge University Press.</td></tr>
<tr><td>Course Outcomes</td><td>1 Understand basic aspects of fermentation process
2 Learn production of enzymes and its application
3 Understand theoretical and practical aspects of production of different products through fermentation
4 Learn various techniques used in food biotechnology
5 Understand biotechnological aspects for the for the production of functional food</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>Mapping between COs and PSOs
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO5</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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Course code	**FSQ 513**
Course title	**Fundamentals of microbial controls in foods**
Corse credit	**4 (2+2)**
Teaching per Week	**6 h**
Course Objective (CO)	• To gain basic and applied knowledge about microorganisms • To understand growth requirement of the microorganisms • To learn theoretical and practical aspects food preservation methods • To study quality attributes of foods after preservation
Course Content	**Theory** UNIT I Introduction Introduction: scope of food microbiology Microorganisms important in food industry Types of microorganisms, their importance in foods, classification of food borne bacteria, their morphology and distinguishing features with examples. UNIT II Growth of microorganisms in foods Intrinsic (pH, moisture content, redox potential, nutrient content, antimicrobial constituents and biological structures) and extrinsic factors (temp., RH, presence and concentration of gases) governing growth of microorganisms in food. UNIT III Food Preservation: Principles of preservation, methods of food preservation – high temperature, low temperature, drying, radiation, chemical preservatives, bio-preservatives, hurdle technology, active packaging, novel processing technologies. UNIT IV Special topics in safety: Microbial attachment and biofilm formation, microbial metabolism of food components, food preservatives of microbial origin, bacteriocins and nanotechnology, food spoilage by microbial enzymes, opportunistic bacterial pathogens, molds and mycotoxins, viruses, parasites, fish and shell fish toxins. **List of practical:** • Methods of sampling. • Concept of shelf life of different foods • To study the concept of asepsis and sterilization • Determination of pH of different foods using pH meter. • Study quality characteristics of foods preserved by drying. • Study quality characteristics of foods preserved by dehydration. • Study quality characteristics of foods preserved by freezing. • To perform pasteurization of fluids using different methods. • To perform blanching of different plant foods. • To study the thermal destruction curve. • Industrial Visits

<table>
<tr><td>References:</td><td>1. Fundamental Food Microbiology, Arun Bhunia Bibek Ray, CRC Press.
2. Modern Food Microbiology, J M JAY, APAC.
3. Microbiology of Safe Food, S J Forsythe, Blackwell Science.
4. Microbiology of foods, J C Ayres, J O Mundt, W E Sandine, W H Freeman Elsevier.</td></tr>
<tr><td>Course Outcomes</td><td>1. Understand microorganisms and its related aspects
2. Understand theoretical and practical aspects of microbial growth
3. Explore theoretical and practical aspects food preservation methods
4. Explore quality attributes of foods after preservation</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>Mapping between COs and PSOs
<table>
<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td></tr>
<tr><td>CO1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>CO3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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<tr><td>Course code</td><td>FSQ 603</td></tr>
<tr><td>Course title</td><td>Quality assurance in food supply chain</td></tr>
<tr><td>Corse credit</td><td>3 (3+0)</td></tr>
<tr><td>Teaching per Week</td><td>3 hrs</td></tr>
<tr><td>Course Objective (CO)</td><td>• To understand food safety regulations
• To understand risk assessment and management
• To learn quality control methods
• To learn supplier management</td></tr>
<tr><td>Course Content</td><td>Theory
Modern food safety risk analysis and management, food defense plan and food fraud mitigation plan, beyond HACCP: TACCP and VACCP, advanced block chain and IoT technology behind the lifecycle traceability–Indian requirements and simple solutions, enzymes as analytical tools for the assessment of food quality and safety, nanoparticles as biosensors for food quality and safety assessment, advances in food identification and authentication with modern analytical tools, emerging real time quality depicting packaging solutions. Supply chain research gaps pertaining to temperature abuse, transportation pallet tracking, refrigerated container management, automated systems in final distribution, clean labels etc.</td></tr>
<tr><td>References:</td><td>1. Naomi Rees. David Watson. 2000. International standards for food safety, Aspen Publications.
2. Assuring food safety and quality. 2012. FAO Food and Nutrition Manual., FAO publications, Rome.</td></tr>
<tr><td>Course Outcomes</td><td>1. Understand food safety regulations
2. Learn risk identification and its mitigation
3. Understand quality control methods
4. Understand supplier management</td></tr>
<tr><td>Mapping between COs with PSOs</td><td>Mapping between COs and PSOs
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<tr><td></td><td>PSO1</td><td>PSO2</td><td>PSO3</td><td>PSO4</td><td>PSO5</td><td>PSO6</td><td>PSO7</td></tr>
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Course code	**FSQ 605**
Course title	**Food and nutraceutical chemistry**
Corse credit	**3 (3+0)**
Teaching per Week	**3 hrs**
Course Objective (CO)	1. Learn mechanism of action of nutraceuticals compounds 2. Study impacts of nutraceuticals for various diseases 3. Familiarize the students about complications and toxicity potential of nutraceuticals 4. Learn regulatory developments of nutraceuticals in health claims 5. Understand the proprietary claims of various nutraceuticals
Course Content	**Unit 1**: Recent advances in mechanism of action and chemical properties of potential and established nutraceutical compounds and their applications in functional foods -Updates in chemistry of Nutraceuticals with diseases modifying indications modifying potential for Allergy, Alzheimer's disease and nutraceuticals, Cardiovascular diseases, Cancer, Diabetes, Eye disorders, Immune system, Inflammation, Obesity, Parkinson's, Alzhaimar etc. Complications and toxicity potential of nutraceuticals, Modern approaches regulatory clearance and ban of nutraceutical. **Unit 2**: Regulatory developments in health claims. Disease risk reduction claims and proprietary claims – recent protocols for phytosterols, digestible starch, slowly digestible starch, flavanols, grain / millet fibre, glucomannan, guar gum and hydroxyl propyl methyl cellulose and fructose etc.
References:	1. Robert E.C.2006. Handbook of Nutraceuticals and Functional Foods. 2nd Ed. Wildman. 2. Chintale Ashwini et al. 2013. Role of Nutraceuticals in Various Diseases: A Comprehensive Review.ISSN:2231-2781. 3. Barbara Schneeman. 2015. Science-Based Regulatory and Policy Considerations in Nutrition, American Society for Nutrition. Adv. Nutr. 6:361S–367S, 2015; doi:10.3945/an.114.007013.
Course Outcomes	CO1: Recognize the importance and recent advances in mechanism of action nutraceuticals compounds CO2: Understand chemical properties of nutraceuticals CO3: Understanding the importance of nutraceuticals with diseases modifying indications modifying potential for Allergy, Alzheimer's disease, Cardio vascular diseases, Cancer etc CO4: Recognize the regulatory developments of nutraceuticals compound in health claims CO5: Understanding the proprietary claims of various nutraceuticals for disease risk reduction claims and proprietary claims
Mapping between COs with PSOs	**Mapping between COs and PSOs**

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	■	■				■	■
CO2		■			■	■	
CO3			■	■	■	■	■

	CO4								
	CO5								