



First Year Curriculum

Admission Year 2026-27

**M. Tech
Food Technology**

Faculty of Agriculture

Parul Institute of Technology

Parul University

Vadodara, Gujarat, India

Semester 01

Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of Food Processing and Preservation, Food Engineering, Heat and Mass Transfer, Food Microbiology, and Unit Operations in Food Processing. Understanding of conventional thermal and non-thermal processing methods will help students to comprehend advanced and emerging food processing technologies.
Rationale	The course is designed to provide knowledge of emerging and advanced food processing technologies used in the modern food industry. Conventional food processing methods often affect nutritional quality, sensory attributes, and shelf life of foods.
Course Code	20201101
Course Title	Emerging Technologies in Food Processing
Credits	3(2+1)
Objectives of the course	The course aims to provide understanding of advanced and emerging food processing technologies and their applications in the food industry. It focuses on the principles and operational aspects of membrane technology, supercritical fluid extraction, microwave and radio frequency processing, hurdle technology, high pressure processing, ultrasonic processing, and other novel preservation methods. The course also develops knowledge regarding the effects of these technologies on food quality, safety, shelf life, and nutritional characteristics. Students will gain exposure to modern industrial applications and recent innovations such as nanotechnology and cryo-processing in foods.
Syllabus	
Theory	<p>Unit I Membrane Technology: Pressure activated membrane processes: MF, UF, NF and RO and their industrial application. Membrane distillation. Supercritical fluid extraction: Concept, property of super critical fluids SCF, extraction methods, application in food processing.</p> <p>Unit II Microwave and radio frequency processing: Advantages, mechanism of heat generation, application in food processing: microwave blanching, sterilization and finish drying. Hurdle technology: Concept and Principle, Preservation techniques as hurdles and their principles, hurdle tech foods.</p> <p>Unit III High Pressure processing: Concept, equipment for HPP treatment, mechanism of microbial and enzyme inactivation and its application in food processing, effect on food constituents. Ultrasonic processing: Properties of ultrasonic, types of equipment, application of ultrasonic as processing technique.</p> <p>Unit IV Newer techniques in food processing: principle and application of High intensity light, pulse electric field, ohmic heating, IR heating, inductive heating, cold plasma, and pulsed X-rays in food processing and</p>

	preservation, Cryo-processing of foods Nanotechnology: Principles and applications in foods.
Practical	<ul style="list-style-type: none"> • To evaluate the characteristics of treated water using RO system • To study production and characteristics of treated water using, microfiltration, UF, NF and RO system • To study the effect of ultrafiltration process on fruit juices quality • To study suitability and production of fruit juices using ultrafiltration • To study the effect of microfiltration process on milk quality • To study super critical fluid extraction system and to carry out extraction of bioactive compound from selected samples • To carry out extraction of lycopene from tomato using SCFE system • To study microwave system and to evaluate the effect of different power on drying characteristics of selected vegetable products • To study microwave blanching of vegetable and determination of blanching efficacy. • To study the ultrasonicator and evaluate the effect of ultra-sonication on microorganism in sample • To study the ultrasonicator and to evaluate the effect of ultra-sonication on extracted juice yield from fruit pomace • To evaluate the different pre-treatment on oil yield from oil seed cake • To prepare nano emulsion and study of their characteristics • To study ohmic heating system and to study the processing of fruit pup using ohmic heating system • To visit food industries utilizing advance food processing techniques • To study the effect of different drying techniques/ hybrid drying techniques on fruits and vegetables.
Course Outcomes	<p>CO1: Explain the principles, equipment, and industrial applications of membrane technology and supercritical fluid extraction in food processing.</p> <p>CO2: Describe the mechanism and applications of microwave, radio frequency, and hurdle technologies used for food preservation and processing.</p> <p>CO3: Analyze the principles and applications of high pressure and ultrasonic processing and evaluate their effects on microorganisms, enzymes, and food constituents.</p> <p>CO4: Discuss the principles, advantages, and food applications of emerging technologies such as pulsed electric field, ohmic heating, cold plasma, cryo-processing, and nanotechnology in food systems.</p>
Suggested Readings	<ul style="list-style-type: none"> • Gould GW, 2000. New Methods of Food Preservation, CRC Press. • Barbosa-Canovas, 2002. Novel Food Processing Technologies, CRC Press. • Dutta AK & Anantheswaran RC. 1999. Hand Book of Microwave Technology for Food Applications, CRC Press. • Sun DW, 2015. Emerging Technologies for Food Processing, Elsevier Ltd. • Kudra T and Mujumbar AS, 2009. Advanced Drying Technologies, CRC Press. • Nema PK, Kaur BP and Mujumdar AS, 2018. Drying Technologies for Foods: Fundamentals and Applications, CRC Press

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	2	3	20	10	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of Food Chemistry, Human Nutrition, Food Processing Technology, Food Microbiology, Biochemistry, and Food Packaging. Understanding of bioactive compounds, health-related food components, and food preservation techniques will help students comprehend the development and application of nutraceuticals and functional foods.
Rationale	The course is designed to provide knowledge of nutraceuticals and functional foods that promote health, prevent diseases, and improve overall well-being. With increasing consumer awareness regarding health and nutrition, the food industry is focusing on the development of value-added foods containing bioactive compounds such as probiotics, omega fatty acids, phenolics, and antioxidants. This course enables students to understand the chemistry, functionality, processing, packaging, safety, and regulatory aspects of nutraceuticals and functional foods. It also introduces emerging concepts such as nutrigenomics, personalized nutrition, nanotechnology, and delivery systems used in modern functional food industries.
Course Code	20201102
Course Title	Nutraceuticals and Specialty Foods
Credits	3(2 + 1)
Objectives of the course	The course aims to develop understanding of nutraceuticals, functional foods, and their role in health promotion and disease prevention. It focuses on bioactive compounds, specialty foods, functional beverages, extraction and delivery systems, and the effect of processing on nutraceutical ingredients. The course also provides knowledge regarding packaging, storage, labelling, marketing, safety regulations, and emerging technologies such as nanotechnology and nutrigenomics in functional food development. Students will gain exposure to industrial applications and innovations in health-oriented food products.
Theory	Unit I Introduction: Defining nutraceuticals and functional foods. Nature, type and scope of nutraceutical and functional foods. Nutraceutical and functional food applications and their health benefits. Nutraceutical

	<p>compounds and their classification based on chemical and biochemical nature, Innovations in Functional Food Industry for Health and Wellness, Development of biomarkers to indicate efficacy of functional ingredients. Nutraceuticals and Functional foods: Nutraceuticals/ food components for specific disease such as cancer, heart disease, diabetes, obesity, anti-aging, arthritis, Prebiotics and probiotics; Omega 3 and omega 6 fatty acids, Isoflavones, phenolic compounds, catechins, lycopene, glucosinolates.</p> <p>Unit II Specialty Foods: Design of food for infants, children and old age. Functional Beverage: Selection of ingredients, health benefits and production. Extraction and delivery system: Non-thermal techniques, bioprocessing techniques, dehydration techniques, effect on bioactive ingredients. Delivery system and controlled release of nutraceuticals</p> <p>Unit III Packaging, Storage, labelling: Packaging requirements, storage and storage kinetics on quality of nutraceuticals, interactions of various environmental factors. Marketing and safety aspects: Marketing and safety and regulatory issues for functional foods and nutraceuticals.</p> <p>Unit IV Nutrigenomics: concept of personalized medicine. Use of nanotechnology in functional food industry. Biological functionality of cruciferous vegetables, tropical, subtropical and temperate fruits, herbs and spices.</p>
Practical	<ul style="list-style-type: none"> • Determination of antioxidant activity of given food sample by different techniques, viz. DPPH, FRAP, ABTS, FRAP. • Determination of total phenolic content of given food sample. • Estimation of dietary fibres of given food sample. • Estimation of lycopene in tomato. • Estimation of carotenoids of given food sample. • Determination of total flavonoid content of given food sample • Effect of heat processing on ascorbic acid • Determination of vitamins A. • Estimation of pectic substances in plant sample • Determination of beta carotene of given food sample. • To determine gas chromatography for bioactive components analysis. • To study the effect of drying on bioactive components of food sample • To study the packaging requirement of functional foods. • Determination and qualifications of some nutraceutical and functional food compounds by HPLC • Estimation of a- glucan • To study the storage kinetics of nutraceutical. • Estimation of soluble/insoluble fibres of given food sample.
Course Outcomes	<p>CO1: Explain the concepts, classification, health benefits, and applications of nutraceuticals and functional foods in disease prevention and wellness.</p>

	<p>CO2: Describe the formulation and processing of specialty foods, functional beverages, and delivery systems used for nutraceutical ingredients.</p> <p>CO3: Analyze the packaging, storage, labelling, marketing, and regulatory aspects associated with nutraceuticals and functional food products.</p> <p>CO4: Discuss the applications of nutrigenomics, nanotechnology, and biologically functional food components in the development of health-oriented food products.</p>
Suggested Readings	<ul style="list-style-type: none"> • Chadwick R Henson S and Moseley B, 2003. Functional Foods, Springer-Verlag. • Jeffrey Hurst W, 2008. Methods of Analysis for Functional Foods and Nutraceuticals, CRC Press. • Shi J, Mazza G and Maguer M, 2002. Functional Foods, CRC Press. • Wildman REC, 2006. Handbook of Nutraceuticals and Functional Foods, CRC Press. • Vattem DA and Maitin V, 2016. Functional Foods, Nutraceuticals and Natural Products, DEStech publications. • Grumezescu AM, 2016. Nutraceuticals: Nanotechnology in the Agri-Food Industry, Elsevier, Inc • Rizvi SSH, 2010. Separation, Extraction and Concentration Processes in the Food, Beverage and Nutraceutical Industries, Woodhead Publishing. • Tomar SK, 2011. Functional Dairy Foods Concepts and Applications, Satish Serial Publishing House. • Gupta RK, Bansal S and Mangal M, 2012. Health Food Concept, Technology and Scope, Biotech Books.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	2	3	20	10	20	50	-	100

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Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of Food Chemistry, Food Engineering, Food Physics, Heat and Mass Transfer, and Food Processing Operations. Understanding of physical properties of biological materials and fundamentals of thermodynamics and rheology will help students comprehend the engineering and functional behaviour of food materials during processing and storage.
Rationale	The course is designed to provide knowledge of the physical, mechanical, thermal, rheological, and functional properties of food and

	<p>biomaterials that influence food processing, product development, quality, and storage stability. Understanding these properties is essential for designing food processing equipment, optimizing processing conditions, evaluating texture and sensory quality, and developing innovative food products.</p>
Course Code	20201103
Course Title	Food Material and Product Properties
Credits	3(2 + 1)
Objectives of the course	<p>The course aims to develop understanding of the engineering and functional properties of food and biomaterials relevant to food processing and product development. It focuses on physico-chemical, mechanical, rheological, thermal, electrical, and optical properties of foods and their significance in processing operations. The course also provides knowledge regarding food microstructure analysis, sensory attributes, sorption behaviour, and functional characteristics such as gelatinization, emulsification, and foaming. Students will gain the ability to correlate material properties with food quality, texture, stability, and processing performance.</p>
Theory	<p>Unit I Introduction: Biomaterials and their properties in relation to processing and product development. Physico-chemical characteristics: Shape, sphericity, size, volume, microstructure, density, porosity, surface area, coefficients of friction and angle of repose and influence of constituents on processing.</p> <p>Unit II Mechanical and rheological properties: Flow behaviour of granular and powdered food materials, rheological models, creep phenomenon, stress – strain - time effects and relationships, and techniques of model fitting, Elastic vs. textural characteristics and textural profile analysis of food products.</p> <p>Unit III Thermal, electrical and optical properties: Specific heat, thermal conductivity, phase transition, thermodynamics-basic principles and laws, Thermodynamic properties of moist air, kinetics of water absorption, heat capacity, thermal diffusivity, electrical resistance and conductance, dielectric constant, reflectivity, transmittivity and absorptivity of incident rays. Food microstructure: Methods and systems for food microstructure, determination of light microscopy, transmission electron microscopy, scanning electron microscopy, other instrumentation and techniques, image analysis: image acquisition, image processing, measurement analysis.</p> <p>Unit IV Functional properties: Dextrinization, Gelatinisation, Crystallisation, gelation, foaming, coagulation, denaturation and syneresis, foaming, emulsification. Sensory attributes: Sensory properties and correlation with objective indices, microstructure and its relation to texture from</p>

	<p>their mechanical models and its examination. Sorption behaviour of food: sorption isotherm, modelling.</p>
Practical	<ul style="list-style-type: none"> • To determine physical dimension and shape for suitability of processing and packaging of food materials • To determine bulk, true density and porosity of samples • To determine the angle of repose using rough and smooth surface • Analysis of powder characteristics using powder flow analyser. • To determine the mixing and strength characteristics of wheat flour using faringograph/ mixograph/ mixolab. • To determine the amylolytic activity using falling number of wheat flour. • Development of stress and strain curve and to study viscosity of Newtonian and non-Newtonian fluid. • Effect of temperature on viscosity profile of a food sample. • Texture profile analysis of foods samples. • Effect of temperature on textural profile of food • Determination of thermal properties of foods using DSC. • To estimate dielectric constant of foods • Organoleptic evaluation of food materials • TEM and SEM, image analysis and image processing techniques • To determine water activity of food • To determine colour value of food, viz. Lab, whiteness index, yellow index, browning index
Course Outcomes	<p>CO1: Explain the physico-chemical properties of biomaterials and their influence on food processing and product development.</p> <p>CO2: Describe the mechanical and rheological behaviour of food materials and evaluate their textural and flow characteristics using rheological models.</p> <p>CO3: Analyze the thermal, electrical, optical, and microstructural properties of foods and their applications in food processing and quality evaluation.</p> <p>CO4: Discuss the functional, sensory, and sorption properties of food materials and correlate them with food stability, texture, and product quality.</p>
Suggested Readings	<ul style="list-style-type: none"> • Rao MA and Rizvi SSH, 1986. Engineering Properties of Foods, Marcel Dekker. • Aguilera JM & Stanley DW, 1999. Microstructural Principles of Food Processing and Engineering, Springer. • Mohsenin NN, 1986. Physical Properties of Plant and Animal Materials, Gordon & Breach Science. • Bourne MC, 1981. Food Texture and Viscosity; Concept and Measurement, Academic Press. • Steffe JF, 1992. Rheological Methods in Food Process Engineering, Freeman Press. • Aguilera JM, 1999. Micro Structure: Principles of Food Processing Engineering, Springer.

	<ul style="list-style-type: none"> • Rahman MS, 2009. Food Properties Handbook, CRC Press. • Serpil S & Sumnu SG, 2006. Physical Properties of Foods, Springer-Verlag. • Pomeranz Y, 1991. Functional Properties of Food Components, Academic Press
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Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
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Program	M. Tech Food Technology
Prerequisite	Students should have basic knowledge of food chemistry, biochemistry, food processing operations, and microbiology along with an understanding of food components such as carbohydrates, proteins, lipids, pigments, and packaging materials.
Rationale	The course provides comprehensive knowledge of the chemical, nutritional, and functional properties of food constituents and their behavior during processing and storage. It helps students understand reactions affecting food quality, shelf-life, flavour, safety, and packaging interactions. The course also emphasizes emerging concerns related to processing-induced toxic compounds and modern approaches for their prevention and control, enabling students to develop safer, nutritious, and high-quality food products for the food industry.
Course Code	20201104
Course Title	Advanced Food Chemistry
Credits	3(2+1)
Objectives of the course	<ul style="list-style-type: none"> • To understand the composition, nutritional significance, and functional properties of major food constituents and their changes during processing and storage. • To study the physicochemical properties and interactions of proteins, lipids, carbohydrates, pigments, and water in food systems. • To acquire knowledge of food flavours, flavour encapsulation techniques, stabilization methods, and their industrial applications. • To develop understanding of processing- and packaging-induced toxic compounds and their prevention and control in food products.
Syllabus	
Theory	Unit I

	<p>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.</p> <p>Unit II 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, \square - fatty acids, trans fatty acids, phytosterol, etc.</p> <p>Unit III 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.</p> <p>Unit IV 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 fibres or semicarbazide from a foaming agent in the plastic gasket.</p>
Practical	<ul style="list-style-type: none"> • Estimation of protein content in food samples using spectroscopic methods • Study of effect of heat on protein denaturation using enzymes • Study of effect of various salt solutions on solubility of proteins • Separation of milk proteins by salting out method • Separation of proteins using chromatographic methods • Fractionation of proteins • Extraction and purification of essential oil/ flavouring compound of a natural source • Study the process of starch retrogradation, gelatinization and modification • Estimation of crude and dietary fibres in given food sample • Analysis of resistant starches • Estimation of various antioxidants, polar compounds and free fatty acids in frying oils • Extraction and purification of natural plant pigment • Functional properties and isoelectric point of proteins • Qualitative evaluation of processing and packaging induced chemicals • Qualitative identification of different flavouring compounds

Course Outcomes	<p>CO1: Explain the composition, nutritional value, functional properties, and chemical reactions of food constituents affecting food quality and shelf-life.</p> <p>CO2: Describe the physicochemical properties and functional behavior of proteins and lipids in different food matrices and processing conditions.</p> <p>CO3: Apply principles of flavour chemistry and encapsulation techniques for stabilization and utilization of flavours in food products.</p> <p>CO4: Analyze the formation, effects, and control measures of processing- and packaging-induced toxic compounds to ensure food safety and quality.</p>
Suggested Readings	<ul style="list-style-type: none"> • Fennema OR, Ed., 2008. Food Chemistry, Marcel and Dekker, Inc., New York, NY. • Belitz HD, Grosch W and Schieberle P. 2009. Food Chemistry. Springer. • Varelis P, Melton L and Shahidi F. 2019. Encyclopedia of Food Chemistry. Elsevier. • Cheung P, Mehta CK and Bhavbhuti M. 2015. Handbook of Food Chemistry. Springer

Teaching & Examination Scheme

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Program	M. Tech Food Technology
Prerequisite	Students should have basic knowledge of food microbiology, food chemistry, food preservation techniques, heat transfer, and principles of food processing engineering. Understanding of microbial growth, kinetics, and food safety concepts will help students comprehend predictive microbial modeling and food safety management systems effectively.
Rationale	This course provides comprehensive knowledge of food safety hazards, microbial kinetics, predictive microbiology, and storage systems used in food industries. It helps students understand the behavior of microorganisms under different processing and storage conditions and enables them to apply mathematical and engineering principles for

	ensuring food safety, quality assurance, shelf-life prediction, and process optimization in food processing industries.
Course Code	20201105
Course Title	Food Safety & Storage Engineering
Credits	3(2+1)
Objectives of the course	<ul style="list-style-type: none"> • To develop understanding of foodborne pathogens, food spoilage organisms, and food safety management systems. • To study the effects of intrinsic, extrinsic, and processing parameters on microbial growth and inactivation. • To understand predictive microbial modeling approaches and their applications in food process design and risk assessment. • To impart knowledge on storage systems, post-harvest physiology, and factors affecting quality deterioration of food commodities.
Syllabus	
Theory	<p>Unit I Overview of food microbiology: Foodborne illness, food spoilage, food fermentation, microbiological physiology and food preservation, microbiological analysis, safety management systems. Overview of foodborne pathogens: Bacterial pathogens, food borne viruses and parasites.</p> <p>Unit II Chemical safety of foods: nature of chemical hazards in foods, food safety engineering and control of chemical hazards, food allergen control. Intrinsic and extrinsic parameters for microbial growth and heat inactivation: Intrinsic and extrinsic factors affecting microbial growth, factors affecting heat resistance, combining traditional peroration techniques.</p> <p>Unit III Kinetics of microbial inactivation: Microbial inactivation kinetics based on food processing methods: thermal, pressure, pulsed electric field, microwave and radio frequency, ohmic and inductive heating etc. Kinetic parameter for the inactivation of pathogens: <i>Salmonella</i>, <i>Listeria monocytogenes</i>, <i>Staphylococcus aureus</i>, <i>Escherichia coli</i>, <i>Bacillus cereus</i>, <i>Clostridium</i>, <i>Vibrio</i>, other pathogens.</p> <p>Unit IV Predictive microbial modelling: classification of models: Kinetic & probability, Empirical & mechanistic models, Primary, secondary & tertiary models, Deterministic & stochastic models; Description of main models, Modelling growth curves, Modelling inactivation/survival curves, Secondary models, Probability models; Applications of predictive microbial modelling: Hazard analysis critical control point (HACCP) & quantitative risk assessment (QRA), Microbial shelf-life studies, Temperature function integration and temperature monitors, Product research and development, Design of experiments; Predictive microbial modelling and quantitative risk assessment.</p> <p>Unit V</p>

	<p>Process-dependent microbial modeling: Predictive microbial kinetic models, Temperature-dependent microbial growth kinetic models, Irradiation-dependent microbial growth model, Pulsed electric field-dependent microbial growth model, High-pressure-dependent microbial growth model; Process modeling; Integration of process and microbial growth kinetic models.</p> <p>Unit VI</p> <p>Storage and handling systems for grains, horticultural and animal based produces; post-harvest physiology of fruits and vegetables; biochemical changes during storage, production, distribution; storage capacity estimate models, ecology, storage factors affecting losses, storage requirements.</p>
Practical	<ul style="list-style-type: none"> • Rapid methods and automation in microbiology: trends and predictions • Study on phage-based detection of foodborne pathogens • Study on real-time PCR • Study on DNA Array • Study on immunoassay • Offline and online assessments for food safety for industry • Storage pest, insects and rodent control • Study on storage systems and structures, Shelf life evaluation of packaged food products • Recent advancements in storage and handling systems • Hygienic design standards and codes for food processing equipment/system • Case studies on food safety engineering, guidelines, regulations.
Course Outcomes	<p>CO1: Explain the principles of food microbiology, foodborne pathogens, spoilage mechanisms, and food safety management systems.</p> <p>CO2: Analyze the influence of chemical hazards, environmental conditions, and processing parameters on microbial growth and inactivation in foods.</p> <p>CO3: Apply predictive microbial models and microbial inactivation kinetics for food safety assessment, process optimization, and shelf-life prediction.</p> <p>CO4: Evaluate process-dependent microbial models and storage systems for maintaining safety and quality of grains, horticultural, and animal-based food products.</p>
Suggested Readings	<ul style="list-style-type: none"> • Sun DW. 2015. <i>Handbook of food safety engineering</i>. Wiley Black Well Academic Press, Elsevier Ltd • International Organization for Standardization. 2018. <i>Food Safety Management Systems: Requirements for Any Organization in the Food Chain</i>. ISO. • Shejbal J. 1980. <i>Controlled Atmosphere Storage of Grains</i>. Elsevier. • Vijayaraghavan S. 1993. <i>Grain Storage Engineering and Technology</i>. Batra Book Service

	<ul style="list-style-type: none"> • Chakraverty A and Singh RP. 2014. Postharvest technology and food process engineering. CRC Press • Chakraverty A, Mujumdar AS and Ramaswamy HS. 2002. <i>Handbook of Postharvest Technology: Cereals, Fruits, Vegetables, Tea, and Spices</i>. CRC Press • ISO. 22000 Food safety management systems - Requirements for any organization in the food chain. Technical Committee ISO/TC 34, Food products and updates • Case Studies and Field Reports - Food Safety Engineering
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Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
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2	-	2	3	20	10	20	50	-	100

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Program	M. Tech Food Technology
Prerequisite	Students should have basic knowledge of food science and technology, fundamentals of economics and management, computer and internet applications, and an understanding of food processing industries and agricultural systems.
Rationale	This course is designed to develop managerial, marketing, financial, and international trade competencies required in the food industry. It provides students with knowledge of business management, consumer behavior, export-import procedures, and global food trade practices. The course also enhances analytical and decision-making skills through exposure to project management, market surveys, and international food business environments, preparing graduates for managerial and entrepreneurial roles in the food and horticultural sectors.
Course Code	20201106
Course Title	Food Business Management
Credits	2(2+0)
Objectives of the course	<ul style="list-style-type: none"> • To provide knowledge of business management principles and their application in food industries. • To develop understanding of materials, personnel, financial, and marketing management practices. • To familiarize students with international trade policies, export-import procedures, and global food business regulations. • To enhance skills in consumer behavior analysis, market research, and project evaluation related to food products.
Syllabus	
Theory	Unit I

	<p>Business management; introduction, theories and functions, food industry management; marketing management and human resource development, personal management. Sectors in food industry and scale of operations in India. Human resource management, study the basics about HR and related policies and capacity mapping approaches for better management. Consumer Behavior towards food consumption, consumer surveys by various institutes and agencies, Various journals on consumer behaviour and market research, Internet based data search.</p> <p>Unit II Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ). Personnel management – recruitment, selection and training, job specialization. Marketing management – definitions, planning the marketing programmes, marketing mix and four P’ s. Financial management – financial statements and ratios, capital budgeting. Project management – project preparation evaluation measures.</p> <p>Unit III International trade; basics, classical theory, theory of absolute advantage. Theory of comparative, modern theory, free trade-protection, methods of protection, quotas, bounties, exchange control, devaluation, commercial treaties, terms of trade, balance of payments, EXIM policy, foreign exchange, mechanics of foreign exchange, GATT, WTO, role of WTO, International Trade in agriculture. World trade agreements related with food business, export trends and prospects of food products in India.</p> <p>Unit IV World consumption of food; patterns and types of food consumption across the globe. Ethnic food habits of different regions. Govt. institutions related to international ad trade; APEDA, Tea board, spice board, wine board, MOFPI etc. management of export import organization, registration, documentation, export import logistics, case studies. Export and import policies relevant to horticultural sector. Project: Consumer Survey on one identified product - both qualitative and quantitative analysis (say, Consumer behavior towards Pickles and Chutneys).</p>
Practical	NA
Course Outcomes	<p>CO1: Explain principles of business management, human resource management, and consumer behavior in the food industry.</p> <p>CO2: Apply concepts of inventory, personnel, marketing, financial, and project management in food business operations.</p> <p>CO3: Analyze international trade theories, WTO regulations, EXIM policies, and export-import trends related to food products.</p> <p>CO4: Evaluate global food consumption patterns, export-import documentation, and conduct consumer survey-based market research for food products.</p>

Suggested Readings	<ul style="list-style-type: none"> • David D and Erickson S. 1987. Principles of Agri Business Management. Mc Graw Hill Book Co., New Delhi. • Acharya SS and Agarwal NL. 1987. Agricultural Marketing in India. Oxford & ISH Publishing Co., New Delhi. • Cundiff Higler. 1993. Marketing in the International Environment, Prentice Hall of India, New Delhi. • Batra GS and Kumar N. 1994. GAD Implications of Denkel Proposals - Azmol Publications Pvt., New Delhi. • Phill Kottler. 1994. Marketing Management - Prentice Hall of India, New Delhi.
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2	-	-	2	40	10	-	50	-	100

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Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of academic learning methods, elementary computer operations, and communication skills. Familiarity with internet browsing, documentation practices, and scientific terminology will help learners understand library resources, information retrieval systems, and research documentation techniques effectively.
Rationale	This course is designed to develop awareness and practical understanding of library systems, information resources, and modern information retrieval techniques. It enables students to efficiently access, organize, evaluate, and utilize scientific and technical information required for academic study, research, and professional development. The course also enhances students' abilities in literature survey, citation practices, bibliography preparation, and use of digital information resources including online databases and internet-based search tools.
Course Code	20201107
Course Title	LIBRARY AND INFORMATION SERVICES
Credits	1(0 + 1)
Objectives of the course	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.
Theory	NA
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; resources access methods.
Course Outcomes	<p>CO1: Explain the functions, organization, and services of libraries along with different classification systems and information sources.</p> <p>CO2: Identify and utilize primary, secondary, and tertiary sources of scientific and technical information for academic and research purposes.</p> <p>CO3: Perform literature surveys using abstracting, indexing, citation databases, OPAC, CD-ROM databases, and internet search tools.</p> <p>CO4: Apply citation techniques, bibliography preparation methods, and modern digital information access systems for research documentation and knowledge management.</p>
Suggested Readings	<ol style="list-style-type: none"> 1. Krishan Kumar – <i>Library Organization</i> 2. C. K. Sharma – <i>Library Management and Organization</i> 3. G. G. Chowdhury – <i>Introduction to Modern Information Retrieval</i> 4. S. R. Ranganathan – <i>The Five Laws of Library Science</i> 5. R. L. Mittal and S. L. Gupta – <i>Library Administration: Theory and Practice</i> 6. H. M. Pattison – <i>Principles of Bibliographical Description</i> 7. Allen Kent – <i>Encyclopedia of Library and Information Science</i> 8. Denis Grogan – <i>Science and Technology: An Introduction to the Literature</i>

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech. (Food Technology)
Prerequisite	Students should possess basic knowledge of science subjects such as chemistry, biology, and laboratory practices acquired at the undergraduate level. Familiarity with elementary laboratory equipment, measurement techniques, and safety practices will help learners effectively perform experimental, analytical, and biological procedures in laboratory and field conditions.
Rationale	This course is designed to provide fundamental practical knowledge and laboratory skills essential for scientific experimentation, analysis, and

	research activities in agricultural and biological sciences. It enables students to understand laboratory safety measures, handling of chemicals and instruments, preparation of solutions and media, sterilization techniques, and operation of common laboratory equipment. The course also develops practical competencies in tissue culture, viability testing, and botanical description of plants, thereby strengthening students' technical and research capabilities.
Course Code	20201108
Course Title	BASIC CONCEPTS IN LABORATORY TECHNIQUES
Credits	1(0 + 1)
Objectives of the course	To acquaint the students about the basics of commonly used techniques in laboratory.
Theory	
Practical	<ol style="list-style-type: none"> 1. Safety measures while in lab. 2. Handling of chemical substances. 3. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel condensers, micropipettes and vaccumets. 4. Washing, drying and sterilization of glassware. 5. Drying of solvents/ chemicals. 6. Weighing and preparation of solutions of different strengths and their dilution. 7. Handling techniques of solutions. 8. Preparation of different agro-chemical doses in field and pot applications. 9. Preparation of solutions of acids. 10. Neutralisation of acid and bases. 11. Preparation of buffers of different strengths and pH values. 12. Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath. 13. Electric wiring and earthing. 14. Preparation of media and methods of sterilization. 15. Seed viability testing, testing of pollen viability. 16. Tissue culture of crop plants. 17. Description of flowering plants in botanical terms in relation to taxonomy.

Course Outcomes	<p>CO1: Demonstrate safe laboratory practices, proper handling of chemicals, glassware, laboratory instruments, and electrical equipment during experimental work.</p> <p>CO2: Prepare and handle chemical solutions, buffers, media, agro-chemical doses, and perform sterilization and neutralization procedures accurately.</p> <p>CO3: Operate common laboratory instruments and equipment such as microscopes, laminar flow units, incubators, viscometers, and micropipettes effectively for scientific investigations.</p> <p>CO4: Apply practical techniques related to seed and pollen viability testing, plant tissue culture, and botanical description of flowering plants for research and agricultural applications.</p>
Suggested Readings	<ol style="list-style-type: none"> 1. Furr AK. 2000. CRC Hand Book of Laboratory Safety. CRC Press. 2. Gabb MH and Latchem WE. 1968. A Handbook of Laboratory Solutions. Chemical Publ. Co.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **AE-** Assignment Evaluation, **ESE-** End Semester Examination

Semester 02

Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of Food Packaging Technology, Food Preservation, Food Chemistry, Food Microbiology, and Polymer Science. Understanding of conventional packaging materials, food spoilage mechanisms, and food quality parameters will help students to understand advanced packaging systems and their industrial applications.
Rationale	The course is designed to provide knowledge of modern and innovative food packaging technologies that enhance food safety, quality, shelf life, and consumer convenience. With increasing demand for minimally processed, safe, and environmentally sustainable food products, advanced packaging systems such as active packaging, intelligent packaging, antimicrobial packaging, modified atmosphere packaging, and biodegradable packaging are becoming essential in the food industry.
Course Code	20201151
Course Title	Emerging Technologies in Food Packaging
Credits	3(2 +1)
Objectives of the course	The course aims to develop understanding of advanced food packaging technologies and their role in food preservation and quality enhancement. It focuses on active and intelligent packaging systems, antimicrobial packaging, freshness indicators, modified atmosphere packaging, and biodegradable packaging materials. The course also provides knowledge regarding packaging-material interactions, recycling of packaging materials, edible films and coatings, and safety and legislative aspects related to food packaging. Students will gain exposure to current innovations and sustainable approaches in packaging technology used in the modern food industry.
Theory	<p>Unit I Active and intelligent packaging: Active Packaging Techniques and intelligent Packaging Techniques, current use of novel Packaging Techniques, consumers and novel Packaging Oxygen, ethylene and other scavengers: Oxygen scavenging technology, selecting right types of oxygen scavenger, ethylene scavenging technology, carbon dioxide and other scavengers. Antimicrobial food packaging: Antimicrobial agents, constructing antimicrobial packaging systems, factors affecting the effectiveness of antimicrobial packaging.</p> <p>Unit II Non-migratory bioactive polymers (NMBP): Advantages of NMBP, Inherently bioactive synthetic polymers: types and application, Polymers with immobilized bioactive compounds and their applications. Time Temperature labels and indicators (TTIs): Defining and classifying TTIs, Requirements for TTIs, development of TTIs, Maximizing the effectiveness of TTIs, Application of TTIs- to monitor</p>

	<p>shelf-life, and optimization of distribution and stock rotation, leakage indicators, oxygen indicators, micro indicators etc. Freshness indicator in packaging: Compounds indicating the quality of packaged food products, freshness indicators, pathogen indicators, other methods for spoilage detection. Self-heating/rehydrating packages.</p> <p>Unit III Packaging-flavour interaction: Factors affecting flavor absorption, role of food matrix, role of differing packaging materials, flavour modification and sensory quality, Study of packaging materials compatibility with foods. Developments in modified atmosphere packaging (MAP): Permeability properties of polymer packaging, measurement of permeability – water and gases. Selection criteria of packaging films, Novel MAP gas, testing novel MAP applications, applying high oxygen MAP. Recycling packaging materials: Recyclability of packaging plastics, improving the recyclability of plastics packaging, testing safety and quality of recycled materials, uses of recycled plastics in packaging.</p> <p>Unit IV Green plastics for food packaging: Problems of plastic packaging wastes, range of biopolymers, developing novel biodegradable materials. Edible Films and Coatings: Properties, types, sources, applications, advantages, disadvantages, theories of plasticization, challenges and opportunities. PFS machine, seal and closures. Safety and legislative aspects of packaging: Regulatory considerations, plastic, metal, paper and glass packaging.</p>
Practical	<ul style="list-style-type: none"> • Determination of WVTR in different packaging materials • Determination of GTR in different packaging materials. • Study of different ethylene scavengers and their analysis • Study of different oxygen scavengers systems and their analysis • Application of anti-microbial packaging for moisture sensitive foods • Evaluation of chemical residue migration from package to food • Application of MAP packaging in selected foods • Study of TTI label, leakage indicators etc. • Determination of oxidative changes in packaged foods • Comparative evaluation of flexible and rigid packages for fragile foods • Packaging of foods under inert atmosphere. • To study textural characteristics of selected fruit/ vegetable under MAP storage • Shelf life evaluation and mode up of packaged food product. • Determination of oil and grease resistant test for packaging films • Determination of respiration rate in fresh fruits and vegetables • Determination of shelf life of fresh fruits and vegetables by using edible coating and films. • Effect of edible coating and films on respiration behaviour, chemical, physical and sensory characteristics of fresh fruits and vegetables. • Visit to food packaging material manufacturing industry

Course Outcomes	<p>CO1: Explain the principles and applications of active, intelligent, oxygen scavenging, and antimicrobial packaging systems used in food packaging.</p> <p>CO2: Describe the concepts and applications of non-migratory bioactive polymers, time-temperature indicators, freshness indicators, and self-heating packaging systems.</p> <p>CO3: Analyze packaging-flavour interactions, modified atmosphere packaging systems, permeability properties, and recycling approaches for packaging materials.</p> <p>CO4: Discuss biodegradable plastics, edible films and coatings, packaging machinery, and safety and legislative aspects associated with food packaging materials and systems.</p>
Suggested Readings	<ul style="list-style-type: none"> • Ahvenainen R, 2001. Novel Food Packaging Techniques, CRC Press. • Robertson GL, 2012. Food Packaging, CRC Press. • Hanlon, JF, Kelsey RJ and Forcinio H. 1998. Handbook of Package Engineering, CRC Press. • Painy FA, 1992. A Handbook of Food Packaging, Blackie. • Rooney ML, 1988. Active Food Packaging, Chapman & Hall. • Coles R and Kirwan M, 2011. Food and Beverage Packaging Technology, Wiley-Blackwell. • Han J and Han J, 2005. Innovations in Food Packaging, Academic Press. • Yam K and Lee D, 2012. Emerging Food Packaging Technologies, Woodhead Publishing.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	2	3	20	10	20	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **AE-** Assignment Evaluation, **ESE-** End Semester Examination

Program	M. Tech. Food Technology
Prerequisite	Student should know the basic knowledge of Food Technology and food engineering and understanding of unit operations, process calculations, and instrumentation along with familiarity with heat transfer, mass transfer, and process control principles also students will get basic knowledge of computer applications and numerical methods.
Rationale	Automation and mathematical modelling have become essential in modern food industries for improving process efficiency, product quality, safety, and productivity. Advanced control systems, sensors, robotics, data acquisition, and simulation tools are widely used for monitoring and optimization of food processing operations. This course

	provides comprehensive knowledge on automation systems, process modelling, simulation, and control techniques applicable to food manufacturing industries, enabling students to address industrial challenges through intelligent and efficient processing solutions.
Course Code	20201152
Course Title	Food Process Automation and Modelling
Credits	2 (2+0)
Objectives of the course	<ul style="list-style-type: none"> • To understand the principles of automation and process control in food processing industries. • To study mathematical modelling and simulation of food processing operations. • To develop knowledge on sensors, instrumentation, PLC, SCADA, and modern control systems used in food plants. • To analyze process optimization, monitoring, and efficiency improvement techniques in automated food systems.
Syllabus	
Theory	<p>Unit I Principles of modelling: Linear programming-concepts, graphical and algebraic solution; Simplex method; Duality theory; Post-optimality analysis; Sensitivity analysis; Transportation and assignment models; Computer applications to LP, queuing theory; Project scheduling and management by PERT-CPM; Integer programming; Non-linear programming; Simulation; Goal programming; Decision theory; Markov chains; Sequencing problem.</p> <p>Food process modelling: The principles of modelling, kinetic modelling, the modelling of heat and mass transfer; introduction diffusion equation, the Navier-stokesequations, heat and mass transfer in porous media Luikov's equation. Modelling thermal processes: cooling and freezing, modelling product heat load during cooling & freezing. Modelling foods with complex shapes, numerical solution of the heat conduction equation with phase change. Modelling thermal processes: heating, introduction, processing of packed and solid foods, continuous heating and cooling processes, Modelling food quality and microbiological safety. Case Studies in Modelling, Control in Food Processes.</p> <p>Unit II</p>

	<p>Food process equipment design: Design considerations of agricultural and food processing equipment. Design of food processing equipment, Dryers, design of dryers.</p> <p>Determination of heat and air requirement for drying grains. Types of heat exchanger. Design of heat exchangers and evaporators. Design of material handling equipment like belt conveyor, screw conveyor, bucket elevator and pneumatic conveyors.</p> <p>Digital image processing: digital representation of image, morphological image processing – dialation, erosion, opening and closing, line and edge detection, thresholding, segmentation, techniques for finding length, breadth, perimeter, surface area, eccentricity and surface roughness of solids. Machine Vision-Based</p> <p>Measurement Systems for Fruit and Vegetable Quality Control in Postharvest.</p> <p>Genetic algorithm optimization: traditional optimization techniques and their limitations, non-traditional method, fitness function in biological evolution, computational procedure for optimization of independent parameters using Genetic algorithm.</p> <p>Artificial neural network modelling: Developing predictive model between independent and dependent parameters by using Artificial neural network –Neural network architecture, weights and bias values of neurons, least square method for NN parameters optimization, matrix representation and computation of the values of NN parameters.</p> <p>Unit III</p> <p>Automation in different unit operations of food processing: Raw food material sorting, grading, size reduction, mixing and agitation, thermal processing, dehydration, packaging, CIP, quality control. Bottle Washing Machine Automation, Bottling Plant Drive System, Demineralization Plant Control System, Labelling</p> <p>Machine Control system, Charger level automation, Reverse Osmosis plant automation, Thermal plant automation, Dehydration and freezing plant automation.</p>
Practical	-
Course Outcomes	<p>CO1: Explain the principles of automation, instrumentation, and process control used in food industries.</p> <p>CO2: Develop mathematical models and simulations for food processing operations.</p> <p>CO3: Apply PLC, SCADA, sensors, and intelligent control systems for automation of food manufacturing processes.</p> <p>CO4: Evaluate process efficiency, quality control, and optimization strategies using modern automation and modelling tools.</p>

Suggested Readings	<ol style="list-style-type: none"> 1. Najim K. 1989. <i>Process Modeling and Control in Chemical Engineering</i> - CRC Press 2. Das H. 2005. <i>Food Processing Operations Analysis</i>. Asian Books Private Limited 3. Ahmed J and Rahman S. 2012. <i>Handbook of Food Process Design</i>. Wiley-Blackwell 4. Tijsskens LMM, Hertog MLATM and Nicolai BM. 2001. <i>Food Process Modelling</i>. Woodhead Publishing 5. • Bernd H. 2017. <i>Measurement, Modeling and Automation in Advanced Food Processing</i>. Springer International Publishing 6. Moreira RG. 2001. <i>Automatic Control for Food Processing Systems</i> Aspen publishers
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Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M.Tech. Food Technology
Prerequisite	A student should have basic knowledge of Food Technology and food chemistry and understanding of organic chemistry, biochemistry, and food processing principles along with familiarity with sensory evaluation and analytical techniques used in food analysis and students will get basic knowledge of food microbiology and food quality management.
Rationale	Flavor is one of the most important quality attributes influencing consumer acceptance of food products. Advances in flavor chemistry, extraction, analytical characterization, and flavor delivery systems have significantly contributed to the development of innovative food products. Understanding the chemical nature, formation, stability, and interaction of flavor compounds is essential for product formulation and quality improvement. This course provides advanced knowledge on flavor compounds, flavor generation mechanisms, sensory perception, analytical techniques, and industrial applications of flavor technology in food systems.
Course Code	20201153
Course Title	Flavour Chemistry and Technology
Credits	2+1
Objectives of the course	<ul style="list-style-type: none"> • To understand the chemistry and sensory perception of flavor compounds in foods.

	<ul style="list-style-type: none"> • To study the formation, extraction, analysis, and stability of flavor components during food processing and storage. • To develop knowledge on flavor enhancement, encapsulation, and flavor delivery technologies. • To familiarize students with industrial applications, quality evaluation, and regulatory aspects of flavors in food products..
Syllabus	
Theory	<p>Unit I Introduction: classification of food flavour, chemical compounds responsible for flavours, difficulties of flavour chemistry research. Anatomy of chemical senses. Chemical compounds classes and their flavour response. Flavour intensifiers: Flavour intensifiers and their effects, Chemistry and technology of various flavour intensifiers. Flavour Extraction: Methods of flavour extraction, isolation, separation and equipments.</p> <p>Unit II Flavour development during biogenesis: Flavour Compounds from Carbohydrates and Proteins, Lipid oxidation. Flavour formulation: Creating and formulating flavour, Synthetic flavours, Blended flavouring, flavour, creation for new products, Delivery of flavours from food matrices. Flavouring compounds during food processing: Volatile and non-volatile flavouring compounds, non-enzymatic browning reactions.</p> <p>Unit III Flavour analysis: Sensory evaluation, discrimination analysis, descriptive analysis, Instrumental analysis (Absorption Spectroscopy (W/VIS), chromatography, mass spectrometry) Food Flavours in different food products: Principal components and properties, baked products, cheese, milk, meat, fish, wine, coffee, tea, chocolate, fruit and vegetable products and fermented foods</p> <p>Unit IV Flavour encapsulation and stabilization: Principles and techniques of flavour encapsulation, types of encapsulation, factors affecting stabilization of encapsulated flavour and their applications in food industry, Packaging and flavour compounds interaction, packaging and storage</p>
Practical	<ul style="list-style-type: none"> • Qualitative identification of different flavouring compounds • Extraction of essential oil/ flavouring compound of basil leave by hydro distillation • Extraction of essential oil/ flavouring compound of basil leave by SCFE

	<ul style="list-style-type: none"> • Comparison of the quality of flavouring component obtained by hydro distillation and SCFE • Extraction of essential oil/ flavouring compound of ginger by SCFE • Effect of storage conditions on flavouring compound of ginger • Preparation of flavour emulsions and their stability • To study effects of staling on food flavours and its adverse effects • Separation, purification and identification of some flavouring compounds by GC/ MS. • Sensory evaluation of different flavours • To check effect of cooking on flavour of food sample • To check effect of fermentation on food flavour • To study sugar caramelization reaction for flavour development • Development of blended food flavour-based products • To study effects of storage conditions on food flavour • Encapsulation of flavouring compounds • To study effects of overdoses of flavours • To study flavour development on roasting/ baking
<p>Course Outcomes</p>	<p>CO1: Explain the chemistry, formation, and sensory characteristics of flavor compounds in food systems.</p> <p>CO2: Analyze flavor changes occurring during processing, packaging, and storage of foods.</p> <p>CO3: Apply modern flavor extraction, encapsulation, and delivery technologies in food product development.</p> <p>CO4: Evaluate quality, safety, and regulatory aspects related to flavors and flavoring substances used in the food industry.</p>
<p>Suggested Readings</p>	<ol style="list-style-type: none"> 1. Reineccius G. 2005. <i>Flavour Chemistry and Technology</i>/ CRC Press 2. Heath HB. 1986. <i>Flavour Chemistry and Technology</i>/ AVI Publ. 3. Piggott JR, Paterson A. 1994/ <i>Understanding Natural Flavours</i>. Springer US 4. Morton ID, Macleod AJ. 1990. <i>Food Flavour</i> Elsevier Science 5. Ashurst PR. 1994. <i>Food Flavours</i> Blackie 6. Taylor AJ and Linforth RST. 2010. <i>Food Flavour Technology</i>/ Blackwell Publishing Ltd 7. Hui YH. 2010. <i>Handbook of Fruit and Vegetable Flavours</i> Wiley & Sons, Inc

	8. Bruckner B and Wyllie SG. 2008. <i>Fruit and vegetable flavour: Recent advances and future prospectus</i> CRC Press.
	9. Ferreira V and Lopez R. 2013. <i>Flavour Science</i> Academic Press

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	2	3	20	10	20	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech Food Technology
Prerequisite	Students should have basic knowledge of food science and technology, food microbiology, food chemistry, food processing, and quality assurance. Familiarity with national food laws, hygiene practices, and international trade concepts will help in understanding global food safety regulations and standards.
Rationale	This course provides comprehensive knowledge of national and international food laws, standards, and regulatory systems governing food safety and international trade. It helps students understand global harmonization of food regulations, risk analysis, import-export requirements, and regulatory compliance essential for food industries operating in domestic and international markets. The course also develops competency in implementing food safety management systems, international quality standards, and legal frameworks to ensure consumer protection and facilitate global food trade.
Course Code	20201154
Course Title	Global Food Laws & Regulations
Credits	2 (2+0)
Objectives of the course	<ul style="list-style-type: none"> • To familiarize students with international food safety organizations, standards, and global regulatory frameworks governing food trade. • To develop understanding of international food safety laws, HACCP systems, and regulatory compliance requirements for food industries. • To impart knowledge about global import-export regulations, food facility registration, inspection systems, and risk analysis approaches. • To provide insights into Indian food laws, standards, and regulatory agencies related to food safety and quality assurance.
Syllabus	

Theory	<p>Unit I 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 of global food laws,</p> <p>Unit II 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 Verification Programs (FSVP), Food Facility Registration, FDA - Current Good Manufacturing Practices (CGMPs)</p> <p>Unit III 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.</p> <p>Unit IV 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 food safety, Legal Metrology Act, International Food Control Systems/ Laws</p>
Practical	NA
Course Outcomes	<p>CO1: Explain the role of international organizations, global food safety standards, and harmonization of food laws in international food trade.</p> <p>CO2: Interpret major international food safety regulations, including EU standards, FSMA, HACCP, and preventive control systems applicable to food industries.</p> <p>CO3: Analyze global regulatory requirements related to food imports, exports, food facility inspections, GM foods, irradiated foods, and emerging food technologies.</p> <p>CO4: Evaluate Indian food laws, regulations, standards, and regulatory frameworks governing food safety, quality control, and food trade.</p>

Suggested Readings	<ul style="list-style-type: none"> • Osiero O. 2018. <i>Food Safety Standards in International Trade: The Case of the EU and the COMESA, CRC</i> • Villarreal AM. 2018. <i>International Standardization and the Agreement on Technical Barriers to Trade</i>, Cambridge University Press • Meulen B, Bremmers H, Purnhagen K, Gupta N, Bouwmeester HL and Geyer L. 2014. <i>Governing Nano Foods: Principles-Based Responsive Regulation</i> • Understanding the Codex Alimentarius, 3rd ed., 2006. • Vapnek J and Spreij M. 2005. <i>Perspectives and Guidelines on Food Legislation, with a new model food law for the Development Law Service</i> FAO Legal Office • US FDA Website • European Food Safety Authority (EFSA) website
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Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech. Food Technology
Prerequisite	Student should know the basic knowledge of Food Technology and food microbiology. Understanding of food processing, sanitation, and quality assurance principles. Familiarity with food safety regulations and hygiene practices. Basic knowledge of hazard analysis and quality management systems.
Rationale	Ensuring food safety and quality is a critical requirement in the global food industry due to increasing consumer awareness, regulatory requirements, and international trade standards. Food Safety Management Systems (FSMS) and certification standards such as HACCP, ISO 22000, GMP, and FSSAI guidelines help industries maintain product safety, traceability, and regulatory compliance. This course provides advanced knowledge on food safety systems, risk assessment, auditing, documentation, and certification procedures essential for modern food industries.
Course Code	20201155
Course Title	Food Safety Management Systems and Certification
Credits	2(2+0)
Objectives of the course	<ul style="list-style-type: none"> • To understand the principles and components of food safety management systems in food industries.

	<ul style="list-style-type: none"> • To study national and international food safety standards, regulations, and certification systems. • To develop knowledge on hazard analysis, risk assessment, auditing, and documentation procedures. • To analyze implementation strategies for maintaining food safety, quality assurance, and regulatory compliance.
Syllabus	
Theory	<p>Unit I Food safety management systems and its requirements for any organization in the food chain, Block chain concept, Global food safety initiative (GFSI), PAS 220, Prerequisite programs on food safety for food manufacturing, Audits: Introduction, objectives, documentation, responsibilities.</p> <p>Unit II Food safety plan overview, Good manufacturing practices and other prerequisite programs, GAP and GMP, Preliminary Steps in Developing a food safety plan, Resources for food safety plans, HACCP, TACCP and VACCP.</p> <p>Unit III Biological/ Chemical/ Physical and Economically motivated food safety hazards, Process preventive controls, Food allergen preventive controls, Sanitation preventive controls, supply chain preventive controls, verification and validation Procedures, Record Keeping Procedures, Recall Plan</p> <p>Unit IV FSMS and FSSC 22000. ISO 22003, ISO 20005 and traceability in food chain, ISO 14000 series – certification and its importance, ISO 17025 - General requirements for the competence of testing and calibration laboratories, BRC Standard, BRC Storage and Distribution, SQF, Southern Rocklobster Seafood, Retailer programs like Woolworths, Coles, Costco and ALDI, Concept of Auditing.</p>
Practical	-
Course Outcomes	<p>CO1: Explain the principles, structure, and importance of food safety management systems and certification standards.</p> <p>CO2: Conduct hazard analysis, risk assessment, and implementation of food safety protocols in food processing industries.</p> <p>CO3: Apply auditing, documentation, traceability, and quality assurance practices for regulatory compliance.</p> <p>CO4: Evaluate food safety systems and certification requirements for improving product quality, consumer safety, and global market acceptance.</p>

Suggested Readings	<p>1.Salazar E. 2013. <i>Understanding Food Safety Management Systems: A Practical Approach to the Application of ISO-22000:2005</i>, Create Space Independent Publishing Platform.</p> <p>2.SO 22000 <i>Standard Procedures for Food Safety Management Systems</i>, 2008, Bizmanualz, Inc.</p> <p>3.Dillon M and Griffith C (ed). 2001. <i>Auditing in the Food Industry - From Safety and Quality to Environmental and Other Audits</i>, CRC Press</p> <p>4.nteaz A. 2003. <i>Food Quality Assurance: Principles and Practices</i>, CRC Press</p> <p>5. Respective certification documents</p>
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Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech Food Technology
Prerequisite	Students should have basic knowledge of food science and technology, elementary statistics, computer applications, and laboratory practices. Familiarity with scientific writing and data interpretation will help in understanding research methodologies and analysis techniques.
Rationale	This course is designed to develop research aptitude among students by providing knowledge of research methodologies, experimental design, statistical analysis, and technical writing. It equips students with the skills required for conducting scientific investigations, analyzing data, interpreting results, and preparing quality research reports while maintaining ethical and professional standards in research activities.
Course Code	20201156
Course Title	Research Methodology
Credits	2(2+0)
Objectives of the course	<ul style="list-style-type: none"> • To impart knowledge on research methodologies, research design, and ethical practices in scientific investigations. • To develop competency in sampling techniques, experimental design, and statistical data analysis. • To train students in hypothesis testing, interpretation of research findings, and use of data processing software. • To enhance skills in technical writing, research reporting, referencing, and intellectual property management.
Syllabus	
Theory	Unit I Introduction to Research, Objective and importance of research, Types of research, steps involved in research, Ethical considerations in

	<p>research, Defining research problem, Research design, Methods of research design, Laboratory safety considerations.</p> <p>Unit II Sampling techniques, Classification of Data, Methods of Data Food informatics Collection, designing of experiments, characteristics of a good design: selection of variables, design matrix, factorial design, fractional factorial design, Principal Component Analysis, Taguchi methods.</p> <p>Unit III Data Analysis and interpretation Data analysis, Statistical techniques and choosing an appropriate statistical technique, Optimization techniques, Bioassays- direct and indirect</p> <p>Unit IV Hypothesis, Hypothesis testing, sampling and Non- sampling errors, Data processing software, statistical inference, Interpretation of results.</p> <p>Unit V Technical Writing and reporting of research, referencing and referencing styles, Research journals, Indexing and citation of journals, acknowledgement, conflict of interest, Intellectual property, plagiarism.</p>
Practical	NA
Course Outcomes	<p>CO1: Explain the fundamentals of research methodology, research design, and ethical considerations in research.</p> <p>CO2: Apply sampling techniques, experimental designs, and statistical tools for collection and analysis of research data.</p> <p>CO3: Interpret research results using appropriate hypothesis testing, optimization techniques, and statistical inference methods.</p> <p>CO4: Prepare technical reports and research documents using proper referencing styles while understanding plagiarism, intellectual property, and publication ethics.</p>
Suggested Readings	<ul style="list-style-type: none"> • Creswell JW. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Sage publications, 2013. • Kumar R. Research Methodology: A Step by Step Guide for Beginners, 2nd Edition, SAGE, 2005. • Kothari CR, Garg G. Research Methodology Methods and Techniques, New Age International publishers, Fourth Edition. • Bower JA. 2009. Statistical Methods for Food Science, Blackwell Publishing • Wilson A. Handbook of Science Communication, 1998, CRC Press • Montgomery DC. 2017. Design and Analysis of Experiments, Willey • Snedecor GW and Cochran WG. 1991. Statistical Methods, 8th Edition, Wiley-Blackwell • Saguy PI. Computer aided techniques in Food Technology, 1983, Taylor and Francis

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
2	-	-	2	40	10	-	50	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech. (Food Technology)
Prerequisite	Students should possess basic knowledge of English language, grammar, and communication skills along with fundamental understanding of research and academic writing practices. Familiarity with computer applications and document preparation tools will help learners effectively develop scientific writing, presentation, and professional communication skills.
Rationale	This course is designed to develop scientific writing, technical communication, and professional presentation skills essential for academic, research, and industrial environments. It enables students to understand the structure and format of scientific documents such as theses, technical papers, review articles, and research reports. The course also strengthens language proficiency, grammar, editing, proofreading, group discussion, interview handling, and presentation abilities required for effective scientific and professional communication.
Course Code	20201157
Course Title	TECHNICAL WRITING AND COMMUNICATIONS SKILLS
Credits	1(0 + 1)
Objectives of the course	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).
Theory	NA
Practical	<ol style="list-style-type: none"> 1. Various forms of scientific writings- theses, technical papers, reviews, manuals, etc. 2. Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion). 3. Writing of abstracts, summaries, précis, citations, etc. 4. Commonly used abbreviations in the theses and research communications. 5. Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations;

	<ol style="list-style-type: none"> 6. Writing of numbers and dates in scientific write-ups. 7. Editing and proof-reading. 8. Writing of a review article. 9. Communication Skills - Grammar (Tenses, parts of speech, clauses, punctuation marks). 10. Error analysis (Common errors), Concord, Collocation, Phonetic symbols and transcription. 11. Accentual pattern: Weak forms in connected speech. 12. Participation in group discussion. 13. Facing an interview. 14. Presentation of scientific papers.
Course Outcomes	<p>CO1: Understand and prepare various forms of scientific and technical writings including theses, research papers, abstracts, summaries, and review articles using appropriate scientific formats and conventions.</p> <p>CO2: Apply principles of scientific documentation including citation methods, illustrations, numbering, abbreviations, editing, and proofreading in research communications.</p> <p>CO3: Demonstrate effective communication skills through proper grammar usage, error analysis, pronunciation, group discussions, and interview participation.</p> <p>CO4: Develop confidence in presenting scientific papers and communicating technical information effectively in academic and professional settings</p>
Suggested Readings	<ol style="list-style-type: none"> 1. Barnes and Noble. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. 2. Chicago Manual of Style. 14th Ed. 1996. Prentice Hall of India. 3. Collins' Cobuild English Dictionary. 1995. 4. Harper Collins. Gordon HM and Walter JA. 1970. Technical Writing. 3rd Ed. 5. Holt, Rinehart and Winston. Hornby AS. 2000. Comp. Oxford Advanced Learner's Dictionary of Current English. 6th Ed. Oxford University Press. 6. James HS. 1994. Handbook for Technical Writing. NTC Business Books. 7. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated, East-West Press. 8. Mohan K. 2005. Speaking English Effectively. MacMillan India. 9. Richard WS. 1969. Technical Writing. 10. Sethi J and Dhamija PV. 2004. Course in Phonetics and Spoken English. 2nd Ed. Prentice Hall of India. 11. Wren PC and Martin H. 2006. High School English Grammar and Composition. S. Chand & Co.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; T- Tutorial; P- Practical; C- Credit; MSE- Mid-Semester Evaluation, AE- Assignment Evaluation, ESE- End Semester Examination

Program	M. Tech. (Food Technology)
Prerequisite	Students should have basic knowledge of science, research, innovation systems, and legal or regulatory frameworks related to technology and biological resources. Familiarity with research activities, product development, and scientific documentation will help learners understand the importance and application of Intellectual Property Rights in academic, industrial, and agricultural sectors.
Rationale	This course is designed to provide comprehensive knowledge of Intellectual Property Rights (IPR), international agreements, and legal frameworks related to innovation, biotechnology, agriculture, and biodiversity. It enables students to understand the significance of protecting inventions, traditional knowledge, plant varieties, and biological resources through patents, copyrights, trademarks, and other intellectual property tools. The course also develops awareness regarding technology transfer, licensing agreements, biodiversity conservation, and legal aspects associated with research and commercialization activities.
Course Code	20201158
Course Title	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE
Credits	1(1 + 0)
Objectives of the course	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.
Practical	
Course Outcomes	<p>CO1: Explain the historical development, importance, and various forms of Intellectual Property Rights along with provisions of TRIPs Agreement and Indian IPR legislations.</p> <p>CO2: Identify protectable subject matters related to patents, copyrights, trademarks, geographical indications, plant varieties, biodiversity, and biotechnology innovations.</p> <p>CO3: Understand legal and ethical issues associated with ownership, protection, conservation, and utilization of biological resources and traditional knowledge.</p> <p>CO4: Apply knowledge of technology licensing, material transfer agreements, research collaboration agreements, and IPR management in research and industrial practices.</p>
Suggested Readings	<ol style="list-style-type: none"> 1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural, Biotechnology. CABI. 2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill. 3. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies. 4. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation. 5. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI. 6. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; The Biological Diversity Act, 2002.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
1	-	-	1	40	10	-	50	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **AE-** Assignment Evaluation, **ESE-** End Semester Examination

Program	M. Tech. (Food Technology)
Prerequisite	Basic knowledge of food science and technology, research methodology, scientific writing, and presentation skills.
Rationale	The seminar course is designed to enhance students' ability to identify recent advances in food technology, critically analyze scientific

	literature, and effectively communicate technical information through oral and written presentations. It also develops confidence, analytical thinking, and professional communication skills required for research and industry.
Course Code	20201159
Course Title	Seminar
Credits	1(0 + 1)
Objectives of the course	<ul style="list-style-type: none"> To develop skills for literature survey and scientific information collection. To improve technical presentation and communication abilities. To enhance critical thinking and analytical skills in emerging areas of food technology. To encourage independent learning and research aptitude among students.
Theory	NA
Practical	Selection of seminar topic related to recent advances in food technology, preparation of seminar report, oral presentation using audio-visual aids, participation in technical discussions, and submission of final seminar report.
Course Outcomes	<p>CO1: Identify and review recent developments and research trends in food technology.</p> <p>CO2: Analyze scientific and technical information critically from various sources.</p> <p>CO3: Prepare and deliver effective technical presentations with proper documentation.</p> <p>CO4: Demonstrate improved communication, discussion, and professional skills.</p>
Suggested Readings	<ul style="list-style-type: none"> Day, R.A. and Gastel, B. How to Write and Publish a Scientific Paper. Cambridge University Press. Alley, M. The Craft of Scientific Presentations. Springer Publication. Peat, J., Elliot, E., Baur, L. and Keena, V. Scientific Writing: Easy when you know how. BMJ Books. Sharma, B.K. Instrumental Methods of Chemical Analysis. Goel Publishing House.

Teaching & Examination Scheme

Teaching Scheme				Evaluation Scheme					
L	T	P	C	Internal Evaluation			ESE		Total
				MSE	AE	P	Theory	P	
-	-	2	1	-	-	100	-	-	100

L- Lectures; **T-** Tutorial; **P-** Practical; **C-** Credit; **MSE-** Mid-Semester Evaluation, **AE-** Assignment Evaluation, **ESE-** End Semester Examination