

**DEPARTMENT OF MICROBIOLOGY  
CH. CHARAN SINGH UNIVERSITY, MEERUT**

**Program: B.Sc.**

**Program Code: FM**

**Program Food microbiology Safety & Quality control**

**Year of Implementation: 2021-2022**

### **Program Outcomes**

After successful completion of B.Sc. program, the students would be able

**PO1:** To get opportunities in higher education. They are also developed on the professional front. It also provides opportunities for career advancement in teaching, research, and industries

**PO2:** To integrate interdisciplinary thinking and practice

**PO3:** To analyse a problem, identify and define the computing requirements with respect to organizational factors appropriate to its solution, and plan strategies for their solution

**PO4:** To design, implement and evaluate information systems, processes, components, or programs and source cost-benefit efficient alternatives to meet desired needs, goals, and constraints

**PO5:** To deploy and use effective skills, tools, and techniques required for an industry/ organization or institute

**PO6:** To live a life inculcated with higher values which enable them to withstand the challenges of life.

### **Program Specific Outcomes**

**PSO1.** Food microbiologists tend to have a natural interest in biology, science, food and the well being of others. They are self-motivated individuals who seek solutions to problems, such as how to make our food products and food product ingredients safer.

**PSO2.** To become a food microbiologist, you need intellectual and emotional stability, as this will not only help you achieve the academic success you will require, it will help you endure the ups and downs of the career, such as when research results aren't achieved as planned. You must also be comfortable working in a laboratory setting, and communicating your findings and opinions to others.

**PSO3.** At present, the scientific, analytical and problem-solving skills developed by microbiology graduates are high in demand by employers. There are various options available to you after studying for a Microbiology degree.

**PSO3.** Food microbiologists often receive greater levels of responsibility and independence in their work activities as they acquire more and more experience. These same levels of responsibility and experience can also be achieved when food microbiologists advance their level of education

**PSO4.** – If you are looking for a job as a Microbiologist in India, your average starting salary as a fresher will be around Rs 3 Lakh p.a. With Experience and ample skills acquired you can climb up the career ladder and grab a pay package of up to Rs 10 lakh p.a

**PSO5.** Food microbiologists are primarily hired by organizations that conduct research concerning food spoilage, food preservation and food-borne pathogens. They also work for organizations involved in raising public awareness regarding food safety, and organizations that are involved in food and food product regulation.

*Amg.*  
16.8.



### Courses/ Papers and their Outcomes (COs)

Semester	Course Code	Course Title	Course Outcome
I	FM-101	Instrumentation	<p>After completion of this course, the student will be able to</p> <p><b>CO1.</b> - Basic principle and functioning of industrial fermenter, scope, relevance and future of microbial biotechnology to mankind.</p> <p><b>CO2.</b> Basic principles and applications of UV-Visible Spectrophotometer, pH meter, Flame photometer, Atomic Absorption Spectrophotometer, Oven, melting point apparatus,</p> <p><b>CO3.</b> Chromatography (paper, thin layer, column, gel filtration, ion exchange, and affinity chromatography), HPLC, FPLC, basic principle and functioning of GC/LC/MS instrument.</p> <p><b>CO4.</b> Principles and applications of Electrophoresis for Proteins and DNA; Isoelectric focusing and 2-D gel electrophoresis; Autoradiography, X-Ray diffraction; PCR, DNA probes, Centrifugation; Ultra-centrifugation, Ultrafiltration, Lyophilization.</p> <p><b>CO5</b> Basic principles and functioning of LAF (Laminar Air Flow), control of microorganism by physical methods: heat, filtration, and radiation; chemical methods: phenolics, alcohols, halogen, organic compound, aldehydes, and sterilizing gases: evaluation of antimicrobial agents, effectiveness.</p>
	FM-102	Microbial Techniques in Food& Water Industry	<p><b>CO1.</b> Types of culture media, simple, complex, synthetic, enriched, selective and differential, pH and buffers, pure culture methods; streak plate, pour plate, and spread plate, maintenance and preservation of microbial cultures.</p> <p><b>CO2.</b> Investigation of food and water borne disease, objective of investigation, personals involved in the investigation, materials and equipments required on field investigation.</p> <p><b>CO3.</b> Direct microscopic examination of food, Detection of pathogens in food and their biochemical characterization. Aerobic plate count, ATP</p>

			<p>bioluminescence, colony forming units Alternative Methods, rapid methods for the detection of specific organisms and toxins</p> <p><b>CO4.</b> Detection of coli forms and indicator organism, most probable number, confirmed, completed test and membrane filter techniques for water.</p> <p><b>CO5</b> Detection of viral pathogen by real time PCR, PCR, Immuno assay, ELISA, and nucleic acid probes method.</p>
FM-103	Microbial Diversity – Prokaryotes		<p><b>CO1.</b> History, Scope and relevance of Microbiology; Current thoughts on microbial evolution including the origin of life; Introduction to microbial biodiversity – distribution, abundance, ecological niche of bacteria and archae.</p> <p><b>CO2.</b> Current status of microbes in the living world, Modern trends in Microbial taxonomy including RNA world; Salient features of bacteria according to the Bergey’s Manual of Determinative bacteriology. Morphology and ultra-structure of bacterial cell.</p> <p><b>CO3.</b> General characters of Arhaea and Gram Positive and Gram Negative bacteria, Important genera of Gram Positive and Gram Negative bacteria Physiological and biochemical protocols for their identification, General characters of Cyanobacteria, their classification, ultra structure and economic importance.</p> <p><b>CO4.</b> :General characters, nomenclature, classification, morphology and ultrastructure of viruses; Capsid and their arrangement; Purification of viruses by adsorption, precipitation, enzymes, serological methods (haeme agglutination and ELISA). Assay of viruses (physical and chemical methods).</p> <p><b>CO5</b> Bacteriophages: Structure and life cycle patterns of T-even phages; one step growth curve; Bacteriophage typing; Structure of Cyanophages, Mycophages; General characters and structure of viroids, Satellites and prions.</p>
FM-104	Microbial Diversity – Eukaryotes		<p><b>CO1.</b> General characteristics of eukaryotic microbes; Ultrastructure and organization of a typical eukaryotic cell (membrane structure and functions, cytoskeleton, intracellular compartments- nucleus, mitochondria, chloroplast and their</p>

			<p>genetic organization); Structure and organization of chromatin; cell division.</p> <p><b>CO2.</b> Current status of fungi; organisms studied by mycologists; General characters, somatic structure, asexual and sexual reproduction of microbiologically, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.</p> <p><b>CO3.</b> Mycotoxins, their identification and determination from food samples; Culture of microfungi from different food samples by damp chamber technique and their identification; examination of various solid and soft foods including water samples for fungal contamination by different cultural methods.</p> <p><b>CO4.</b> General characteristics of algae; Somatic structure, asexual and sexual reproduction of microbiologically important genera of Chlorophyceae, Phaeophyceae, Bacillariophyceae, Rhodophyceae and Dinophyceae. Culture of algal contaminations from various food and water samples; Economic importance of algae.</p> <p><b>CO5</b> General characteristics of Protozoans; Nematodes; Structure and reproduction of microbiologically important genera of protozoans (Entamoeba, Trichomonas, Leishmania, Trypanosoma, Plasmodium) and Nematodes: Ancylostoma, Ascarislumbricoides, Necator; Cestodes: Taeniasolium, Trematodes: Fasciola hepatica.</p>
	FM 105	Practical	FM 101- FM 104
<b>II</b>	FM-201	FOOD AND FOOD SOURCES	<p><b>CO1.</b> Food basics, food groups, food chain, food texture, food intake and its regulation, food and its functions as physiological, body buildings, psychological and social functions, food pattern, food consummation trends, population growth and food production</p> <p><b>CO2.</b> Food from plant sources, food grains, cereals and cereal products, composition of cereals, processing of cereals, Pulses and their nutritional value, processing of pulses, nuts and oilseeds, processing of oilseeds, other horticulture crops, post harvest processing of food crops.</p>

			<p><b>CO3.</b> Food from animal sources, meat and meat products, live stocks poultry and meat production, wholesome of meat production, processed meats, egg and egg products, milk and milk products, dairy by products, fish and fishery products</p> <p><b>CO4.</b> Organic foods, genetically modified food, energy drinks, stimulating drinks, carbonated non alcoholic beverages/soft drinks, comfort foods, infants foods, nutraceuticals, ayurvedic medicinal foods, food taboos.</p> <p><b>CO5</b> Food industry, components and characteristics of the food industry, allied industries, international activities of food industry, processing and value addition, food trade, national food processing policy, food safety.</p>
	FM-202	FOOD MICROBIOLOGY	<p><b>CO1.</b> Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; factors affecting food spoilage, different types of spoilage, food preservation.</p> <p><b>CO2.</b> Bio-deterioration of food items. Bacterial and mycotoxins, Important microbes secreting toxins, chemical nature of important toxins; their role in food poisoning; physiology and mechanism of action, control of toxin contamination.</p> <p><b>CO3.</b> Uses of microbes in meats and poultry products, vegetables etc. Use of microbial enzymes in food; low calorie sweeteners, Flavour modifiers; Food additives.</p> <p><b>CO4.</b> Microbiological examination of milk, standard plate count, direct microscopic count and reductase test, composition of milk, sources of contamination of milk, types of microbes in milk, pasteurization of milk, ability of milk to cause disease.</p> <p><b>CO5:</b>Common food borne pathogens, diseasescaused by them and their symptoms, Disease caused by bacteria,</p>

			molds and yeasts, viral contamination of foods, parasites, Surveillance system for tracking of food borne disease
	FM-203	FOOD CHEMISTRY	<p><b>CO1.</b> Food chemistry, history, water structure and relations in food components, carbohydrates: monosaccharides, oligosaccharides and polysaccharides, starch and cellulose derivatives as food constituents, sugar and related products nutritional value, lipids: components, food lipids and health, antioxidants.</p> <p><b>CO2.</b> Proteins structure and functions, enzymes structure and functions, vitamins structure, types and functions, minerals and nutritional aspects, vegetables and fruits, bioavailability of nutrients.</p> <p><b>CO3.</b> Food oxidants, food pigments, natural and synthetic food colours, flavoring agents, sweeteners, emulsifiers and stabilizers, spices and herbs, food preservatives, organic foods, advantages and disadvantages of organic food, food fortification.</p> <p><b>CO4.</b> Food adulteration, types of adulteration: intentional adulteration, incidental adulteration, Food laws, food standardization and regulation agencies in India, national standards, international standards.</p> <p><b>CO5.</b> Evaluation of food quality, sensory tests, types of tests, objective evaluation and instruments used for texture evaluation.</p>
	FM-204	DAIRY TECHNOLOGY AND MICROBIOLOGY OF DAIRY PRODUCTS	<p><b>CO1.</b> Overview of Dairy industry, Basic functioning of Dairy plant (retention pond-irrigation, retention pond, second – stage lagoon, irrigation, vegetative filter, settling basin, vegetative filter, overland flow, distribution channelized terrace), Dairy industry in India, milk processing.</p> <p><b>CO2.</b> Fermented milk, yeast and lactic fermentation, mold lactic fermentation, natural Fermented Foods micro flora of dairy industry, pro-biotic products, functional food stuffs, industrial</p>

			<p>production of healthier food stuffs, modification of food tastes and healthier production, microbiological hazards in dairy industry</p> <p><b>CO3.</b> Dairy products types(concentrated and dried milk products), health risk of consuming dairy products, back drop of milk preservation methods, refrigeration, milk production level, breeding of milk animals, hormone use, nutrition, pesticide use.</p> <p><b>CO4.</b> Microbiology of spoilage of dairy products, types of spoilage microorganism, source of spoilage, factor affecting spoilage, prevention and control measure, method and detection .</p> <p><b>CO5-</b> Significance of milk and dairy products for humans, consumption of milk hygiene, contamination of milk with extraneous matter, starter culture, component of milk food.</p>
	FM 205	Practical	FM 201- FM 204
<b>III</b>	FM-301	Biostatistics, Computer Applications & Bioinformatics	<p><b>CO1.</b> Introduction to Biostatistics: Definition, Types of statistics, Applications and uses of Biostatistics, Identification and types of variable, Tabulation of data, Graphical presentation (categorical and metric data), charting of data using MSExcel; Sampling techniques; Frequency distribution; Measures of central tendency (mean, median and mode); Measures of dispersion: mean deviation and standard deviation; Correlation and regression.</p> <p><b>CO2.</b> Basic concepts related to probability theory, classical probability. Probability distributions: Introduction and simple properties of Binomial, Poisson, Normal and skewed distribution and their applications in biology. Sampling: Concept of sampling and sampling techniques;</p> <p><b>CO3.</b> Overview of computer systems: Introduction and classification; Components of computer; generation of computers; Number system; Flow chart;</p>



			<p>Basics for operating system (MS-DOS, WINDOWS, Unix and Linux); Introduction to softwares; MS-Office (MS-WORD, Power Point, MS- Excel).</p> <p><b>CO4.</b> Introduction to networking (LAN, WAN, MAN) servers, application of networking, Topologies (Bus Network, Ring Network, Star Network, Mesh Network, Tree Network) and their advantages &amp; disadvantages; Transmission Medias (Coaxial Cable, Fiber Optics, Twisted Pair); Internet, downloading files with anonymous FTP, Gopher, Mosaic.</p> <p><b>CO5.</b> Introduction to Bioinformatics, Role of Bioinformatics; Biological databases: Nucleic Acid Sequence Database, Protein Sequence Database and Protein Structure Database); obtaining BLAST Documentation and Help; Important bioinformatics websites (NCBI, EBI, SIB).</p>
	FM-302	Food Processing, Preservation and Packaging	<p><b>CO1.</b> Introduction to food processing, food container manufacturing, food canning, food science and high processing techniques, shelf life of processed food, food processing of cereals, legumes, oil seeds, fruits and vegetables, dairy products, dairy processing biotechnology, membrane technology in dairy processing and fermentation, flesh food technology, food additives, extruded food, food radiation.</p> <p><b>CO2.</b> Introduction to preservation, types of preservation, natural and artificial preservative agent, class I, II and III preservative agents, methods of preservation, thermal process, Vacuum drying and dehydration, cooking and freezing, food preservation by chemicals, minimal processing of fresh foods,</p> <p><b>CO3.</b> Emerging techniques in food processing, modified atmosphere packaging, genetic engineering.</p> <p><b>CO4-</b> Emerging technologies for minimally processed fresh fruit juices,</p>

			<p>pulse electric field, high hydrostatic pressure.</p> <p><b>CO5-</b> Environmental aspects of food processing technology, food packaging wastes and its environmental aspects, environmental impact on packaging, food processing industry, safety in food processing,</p>
	FM-303	Food Laws and Standards	<p><b>CO1.</b> Introduction to food laws, Prevention of Food Adulteration Act (PFA1954), the preamble of Act, definition, primary food, kinds of adulteration in the Act, adulterated food, article held as court, misbranded food, functional responsibilities of various authority, central food laboratories, role of food inspectors</p> <p><b>CO2.</b> Food safety and quality requirements, voluntary requirement, legal requirement, mandatory provisions prescribed under PFA Act, 1954 and rules 1955, Enforcement of Prevention of Food Adulteration Act (PFA- 1954) by State Government, Ministries and Departments responsible for ensuring food safety and quality in India</p> <p><b>CO3.</b> Food Safety and Standards Act 2006 (FSSA-2006)- rules and regulations 2011, existing food laws in India, salient features of Food Safety and Standards Act 2006, Important provision of FSSA, Essential Commodities Act.</p> <p><b>CO4</b> Codex Alimentarius commission (CAC), Statutes of codex alimantrius commission, needs for harmonizing national standards with codex. WTO implication, SPS agreement, TBT agreement, relation between the codex and WTO, dispute settlement, other international standards setting bodies.</p> <p><b>CO5.</b> Customs Act and Import Control Regulation, other law related to food product (Legal metrology, provisions of Weight and Measure Act 1976, The Insecticides Act 1968, Consumer Protection Act 1986, Customs Act 1962</p>

	FM-304	Principles of Food Safety	<p><b>CO1.</b>Introduction to food safety, hazards to safe food (chemical, biological, physical hazards), contamination and spoilage, food hygiene, food itself, people – safety of food, facilities and equipment, sources of contamination, primary production contamination, purchase, storage, production for packaging, distribution and delivery and service, food quality, food safety challenges, protection food from contamination (chemical, biological, physical hazards), reducing the effect of contamination; Role of food processing industries and sector.</p> <p><b>CO2.</b> History, back ground and structure of HACCP, Food chain steps, biological hazards, chemical hazards, physical hazards, history of HACCP, benefits and barriers in implementing HACCP, HACCP principles, HACCP prerequisites and good hygiene practice, Environmental hygiene, design and facilities in the establishment, equipment, utilities, control of operation, personal health and hygiene, pest control,</p> <p><b>CO3.</b> Principles and implementation of HACCP- Identification of hazards and control measures, determination of significant hazards, determination of critical control points, establishing the critical limits, Establishment of corrective action, establishment of verification procedure, establish documentation and record keeping, validation, general errors in HACCP plan, Quantitative approach in HACCP , implement of HACCP Plan, case studies of HACCP.</p> <p><b>CO4.</b> Introduction to risk analysis, risk management, Risk assessment, and Risk communication.</p> <p><b>CO5.</b> Other food safety practices- Good Agriculture practices, good animal husbandry practices, good manufacturing practices, good retail practices, good transport practices, nutritional labeling, Traceability studies.</p>
	FM 305	Practical	FM 301- FM 304

IV	FM-401	PRINCIPLES OF FOOD QUALITY	<p><b>CO1.</b> Auditing: Scope of the standard terms &amp; definitions, internal audit, External audit, combined audit, Joint Audit. Principal of auditing, competence and evaluations of auditors, quality management principles. ISO 9001: 2000, quality management system, Clauses of ISO 9001: 2000.</p> <p><b>CO2.</b> Standardization and accreditation : Introduction, International accreditation forum (IAF), Internal Laboratory Accreditation Cooperation (IUAC), Quality Council of India (QCI), National Accreditation Board for Testing and Calibration Laboratories (NABL).</p> <p><b>CO3.</b> Quality Control &amp; Selection: Introduction, Legislative requirement, FSA surveillance, Laboratory accreditation and quality control, proficiency testing, Analytical methods: codex Alimentarius commission, European Union, other organizations.</p> <p><b>CO4.</b> Pesticides: Introduction, monitoring pesticides in food, high risk group, human exposure. Mycotoxins: Introduction, Health implications of mycotoxins application of HACCP system to control mycotoxins, preventions and control of mycotoxins.</p> <p><b>CO5.</b> Radiation: Safety of use of irradiated food, preservation of food by radiation, measurement of radiations, specific type of radiations treatment for safety of food, uses of radiations and prevention of food adulteration.</p>
	FM-402	FERMENTATION TECHNOLOGY	<p><b>CO1.</b> Definition and scope of fermentation, basic design and operation of fermenter, microbial growth patterns and kinetics in batch culture, microbial growth parameters. Role of microbes in milk and dairy products,</p> <p><b>CO2.</b> General Principles of culture maintenance and preparation, bacterial culture, yeast culture and mold culture, properties of fermented foods, production of starter culture for dairy industries.</p>

			<p><b>CO3.</b> Food fermentation- bread, malt beverages, wines, distilled liquors, vinegar, fermented vegetables, production of cheeses, butter, yoghurt and fermented milk, oriental fermented foods.</p> <p><b>CO4.</b> Food and enzymes from microorganism, microbial biomass: single cell proteins and myco-protein, production of amino acids, and production of other substances added to foods, production of enzymes, fermented by-products</p> <p><b>CO5.</b> Benefits of fermentation, microbial activities in fermented food, control of microbial activities in fermented food, shelf life of fermented foods, and market of fermented food.</p>
	FM-403	Water And Food Borne Disease	<p><b>CO1.</b> Classification of food borne diseases, Food poisoning, infection, and intoxication, non bacterial toxins and mycotoxins Sea food toxicants. Poisoning by chemicals.</p> <p><b>CO2.</b> Major food and water borne bacteria S.aureus, Pseudomonas, Clostridium, Bacillus, Vibrio, E.coli, Salmonella, Shigella, Major food and water borne Viruses Polio virus, Rotavirus, SARS, Coronavirus, Enterovirus</p> <p><b>CO3.</b> Rapid methods for detecting microbial contaminants in foods, Interpretation and application of result and preventive measure</p> <p><b>CO4.</b> Irradiation replaces other food borne disease, microbiological aspect of food, transmission, symptoms, diagnosis, treatment, prevention of disease, Surveillance system for tracking food borne disease.</p> <p><b>CO5.</b> Natural waters: Sources of contamination, Microbial indicators of fecal pollution and other pollution, Elevated temperature test, IMViC test Water quality test.</p>

	FM-404	PUBLIC HEALTH ENGINEERING AND HYGIENE	<p>: CO1. Individual health parameters, Determinants of Health, Key health indicators, Burden of diseases, Importance and Source of Public-health Data Health status in India: Standards, Relevance to social aspects, Future challenges in public health.</p> <p>CO2. Role of Public, Private and NGO in Health sector, Expenditure in Healthcare, Government Plans and Policies in India, The Global Health Council, The International AIDS Vaccine Initiative, Malaria Vaccine Initiative, World Health Organization (WHO).</p> <p>CO3 Overview of Healthcare Systems in India, Primary healthcare handwashing, immunization, circumcision, Secondary healthcare draining puddles of water, clearing bushes and using insecticides, Tertiary healthcare Hospital interventions intravenous rehydration and surgery, Family planning programs: Contraceptives, Sexuality education promotion of safe sex, Pregnancy risk, infant health.</p> <p>CO4.: Microbiological analysis of food: Direct Microscopic examination of food, Cultural techniques, Enumeration method: Direct count by SPC (Standard plate count) and MPN (Most probable number) Count Physico-chemical method by Dye reduction test, Electrical methods, ATP determination.</p> <p>CO5.: Food Safety Supervisor, Use of gloves, Effective hand washing, Home hygiene, Hygiene in the kitchen, bathroom and toilet, body hygiene, food hygiene, Medical Hygiene at home.</p>
	FM 405	Practical	FM 401- FM 404
<b>V</b>	FM-501	MICROBIAL GENETICS AND MOLECULAR BIOLOGY AND GENETIC ENGINEERING	<p>CO1.: Nucleic acids as genetic information carriers: experimental evidences; DNA structure: historical aspects and current aspects, types of DNA, DNA replication in prokaryotes, steps: initiation, elongation, termination, types of polymerases, central dogma.</p>

			<p>CO2.: Types and structural features of RNA (mRNA, tRNA, rRNA), transcription in prokaryotes and eukaryotes, genetic code, protein synthesis in prokaryotes and eukaryotes, Regulation of gene expression: operon concept, Lac operon, negative and positive regulation.</p> <p>CO3.: Gene structure and functions, mutations, spontaneous and induced mutations, mutagens (physical mutagens: non ionizing radiation, chemical mutagens: base analogues, alkylating agents, deaminating agents, intercalating agents and others), DNA repair mechanisms, gene transfer mechanisms, transposable elements.</p> <p>CO4.: Basics of r-DNA technology, enzymes used in r-DNA technology: DNA ligase, DNA polymerase, Klenow fragment, reverse transcriptase, exonuclease, endonuclease, terminal deoxynucleotidyltransferase, alkaline phosphatase, polynucleotide kinase, restriction enzymes and their types, gene libraries: genomic library, cDNA library.</p> <p>CO5.: PCR and its applications, DNA sequencing methods: dideoxy and chemical methods, DNA finger printing, hybridization; general properties; plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes.</p>
	FM-502	NUTRITIONAL THERAPY	<p>CO1 Sources of Nutrition, Nutritional requirements of a healthy person, Therapeutic nutrition, Nutritional supplements, artificial nutrition, Enteral Nutrition, Parenteral Nutrition. Functional foods, types of functional foods, Nutraceuticals.</p> <p>CO2.: Use of Therapeutic nutrition in Nausea, Vomiting, Swallowing problems, Weight loss and related problems, Allergies, Food allergies, Diagnosis and intolerance, Dietary management of food allergies, Pea nut allergy, Cow milk allergy. Digestive disorders and diets.</p>

			<p>CO3.: Diabetes, types of diabetes, complications associated with diabetes, Therapeutic nutrition and management of diabetes; dietary fat and cholesterol, Renal/kidney conditions, kidney stones, eating the right amount of energy</p> <p>CO4.: Cancer, dietary factors associated with cancer, therapy and nutrition, nutritional side effects and dietary management, metabolic conditions of liver; Hepatitis, Cirrhosis, Gallbladder</p> <p>CO5.: Food for man: use of microbes and microbial enzymes in the improvement of nutritive quality of food, probiotics and Prebiotics, microbiological criteria for food, Fruit juices, Food control.</p>
	FM-503	ENVIRONMENTAL MICROBIOLOGY	<p>CO1. Environmental microbiology, historical perspectives, modern environmental microbiology, overall role of microbes in ecosystem, aeromicrobiology and aquatic microbiology, extremophiles.</p> <p>CO2 Soil microbiology, microbial diversity in surface soils, microbial decomposition of organic matters, microbial successions within and above the soil, biogeochemical cycles- C, N, S, P, etc.</p> <p>CO3 Microbiomics and microbial interactions, microflora of ruminants body, microbes-plant interactions, phyllosphere, rhizosphere, endophytes, mycorrhiza, biopesticides.</p> <p>CO4.: Microbial degradation, deterioration and bioremediation (oil spills), xenobiotics, biodegradation of xenobiotics (pesticides, polythenes), biocorrision of metals, microbe–metal interactions (bioleaching, biomining, biohydrometallurgy), role of biosurfactants.</p> <p>CO5.: Microbes and water potability- purification of potable water, sanitary analysis of water (indicator microbes and methods of their detection), standards( tolerable levels) of water quality of faecal</p>



			contamination, microbes in solid waste and sewage management (small scale and large scale), modern sewage treatment methods – oxidation ponds, trickling filters.
	FM-504	FOOD PACKAGING AND MARKETING	CO1. Introduction, need of food packaging, types of packaging, Forms of packaging. Unit 2: Packaging material, CO.2 Flexible packaging material, Rigid packaging material, Semi-rigid packaging material, Modern packaging concept Unit CO3:Modified atmosphere packaging for minimally processed foods, Active and intelligent packaging. Unit 4: Labelling, Bar coding in packaging, packaging and environment, edible packaging of food, biodegradable plastics. Unit 5: History of food marketing, marketing mix, segmentation of food marketing, criticism, issues, food safety and public health.
	FM 505	Practical	FM 501- FM 504

**DEPARTMENT OF MICROBIOLOGY  
CH. CHARAN SINGH UNIVERSITY, MEERUT**

**Program: B.Sc.**

**Program Code: FM**

**Program food Microbiology Safety & Quality Control**

**Year of Implementation: 2021-2022**

## **Course Structure and Evaluation Scheme**

Course Duration: Six Semesters

Course Type: Regular

Pass Percentage: Theory-...33.., Practical-.....33.....Overall-... (mention as per course/  
program)

Attendance Criterion: As per the norms decided by the statutory body

Maximum marks: 2000

Percentage range for Division:

Marks Range for Grades:

Sem.	Course Code	Course Title	Duration	Lecture Duration	Lect./Weak (Th+Tu+Pr)	Max. Marks=100 (Ext.+ Int.)	Credits	External Exam duration
I	FM-101	Instrumentation	90 hours	60 minutes	6	50+50	6	3 hours
	FM-102	Microbial Techniques in Food & Water Industry	90 hours	60 minutes	6	50+50	6	3 hours
	FM-103	Microbial Diversity – Prokaryotes	90 hours	60 minutes	6	50+50	6	3 hours
	FM-104	Microbial Diversity – Eukaryotes	90 hours	60 minutes	6	50+50	6	3 hours
	<b>Max. Marks of Semester-I</b>						<b>500</b>	
II	FM-201	FOOD AND FOOD SOURCES	90 hours	60 minutes	6	50+50	6	3 hours
	FM-202	FOOD MICROBIOLOGY	90 hours	60 minutes	6	50+50	6	3 hours
	FM-203	FOOD CHEMISTRY	90 hours	60 minutes	6	50+50	6	3 hours
	FM-204	DAIRY TECHNOLOGY AND MICROBIOLOGY OF DAIRY PRODUCTS	90 hours	60 minutes	6	50+50	6	3 hours
	<b>Max. Marks of Semester-II</b>						<b>500</b>	
III	FM-301	Biostatistics, Computer Applications & Bioinformatics	90 hours	60 minutes	6	50+50	6	3 hours

	FM-302	Food Processing, Preservation and Packaging	90 hours	60 minutes	6	50+50	6	3 hours
	FM-303	Numerical Analysis Food Laws and Standards	90 hours	60 minutes	6	50+50	6	3 hours
	FM-304	Principles of Food Safety	90 hours	60 minutes	6	50+50	6	3 hours
	<b>Max. Marks of Semester-III</b>					<b>500</b>		
<b>IV</b>	FM-401	PRINCIPLES OF FOOD QUALITY	90 hours	60 minutes	6	50+50	6	3 hours
	FM-402	FERMENTATION TECHNOLOGY	90 hours	60 minutes	6	50+50	6	3 hours
	FM-403	Water And Food Borne Disease	90 hours	60 minutes	6	50+50	6	3 hours
	FM-404	PUBLIC HEALTH ENGINEERING AND HYGIENE	90 hours	60 minutes	6	50+50	6	3 hours
	<b>Max. Marks of Semester-IV</b>					<b>500</b>		
<b>III</b>	FM-501	MICROBIAL GENETICS AND MOLECULAR BIOLOGY AND GENETIC	90 hours	60 minutes	6	50+50	6	3 hours

		ENGINEERING						
FM-502	NUTRITIONAL THERAPY	90 hours	60 minutes	6	50+50	6	3 hours	
FM-503	ENVIRONMENTAL MICROBIOLOGY	90 hours	60 minutes	6	50+50	6	3 hours	
FM-504	FOOD PACKAGING AND MARKETING	90 hours	60 minutes	6	50+50	6	3 hours	
<b>Max. Marks of Semester-V</b>					<b>500</b>			

**DEPARTMENT OF MICROBIOLOGY  
CH. CHARAN SINGH UNIVERSITY, MEERUT**

**Program: B.Sc.**

**Program Code: FM**

**Program food Microbiology Safety & Quality Control**

**Year of Implementation: 2021-2022**

### Syllabus

Semester	Course Code	Course Title	Syllabus
I	FM-101	Instrumentation	<ol style="list-style-type: none"><li>1. Basic principle and functioning of industrial fermenter, scope, relevance and future of microbial biotechnology to mankind.</li><li>2. Basic principles and applications of UV-Visible Spectrophotometer, pH meter, Flame photometer, Atomic Absorption Spectrophotometer, Oven, melting point apparatus,</li><li>3. Chromatography (paper, thin layer, column, gel filtration, ion exchange, and affinity chromatography), HPLC, FPLC, basic principle and functioning of GC/LC/MS instrument.</li><li>4. Principles and applications of Electrophoresis for Proteins and DNA; Isoelectric focusing and 2-D gel electrophoresis; Autoradiography, X-Ray diffraction; PCR, DNA probes, Centrifugation; Ultra-centrifugation, Ultrafiltration, Lyophilization.</li><li>5. Basic principles and functioning of LAF (Laminar Air Flow), control of microorganism by physical methods: heat, filtration, and radiation; chemical methods: phenolics, alcohols, halogen, organic compound, aldehydes, and sterilizing gases: evaluation of antimicrobial agents, effectiveness.</li></ol>

			<p>6. 1.Nelson D and Cox MM, Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York. 2.Wilson K. and Walker J, Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press. 3.Voet and Voet, Principles of Biochemistry. 4. Willey J, Sherwood L. and Woolverton C., Prescott's Microbiology, McGraw Hill. 5.Upadhyaya and Nath, Biophysical chemistry, Himalaya pub. House.</p>
FM-102	<b>Real Analysis</b>		<p>1. Types of culture media, simple, complex, synthetic, enriched, selective and differential, pH and buffers, pure culture methods; steak plate, pour plate, and spread plate, maintenance and preservation of microbial cultures.</p> <p>2. Investigation of food and water borne disease, objective of investigation, personals involved in the investigation, materials and equipments required on field investigation.</p> <p>3. Direct microscopic examination of food, Detection of pathogens in food and their biochemical characterization. Aerobic plate count, ATP bioluminescence, colony forming units Alternative Methods, rapid methods for the detection of specific organisms and toxins</p> <p>4. Detection of coli forms and indicator organism, most probable number, confirmed, completed test and membrane filter techniques for water.</p> <p>5. Detection of viral pathogen by real time PCR, PCR, Immuno assay, ELISA, and nucleic acid probes method.</p> <p>6 . 1. Adams Food Microbiology. 2.Prajapati, Fundamentals of Dairy Microbiology. 3. John C, Ayres OM, William ES, Microbiology of Foods. W. H. Freeman and Co. 4. Robinson Dairy Microbiology. 5. Jay JM, Modern Food Microbiology. Van Nostraaand Reinhold Co., New York. 6. Andrew Proctor, Alternatives to conventional food</p>

		processing, RSC pub. 7. Frazer WC and Westhoff DC, Food Microbiology. Mcgraw Hill, New York. 8. B.D. Singh, Biotechnology, Kalyani Publication
FM-103	<b>Differential Equations</b>	<p>1. History, Scope and relevance of Microbiology; Current thoughts on microbial evolution including the origin of life; Introduction to microbial biodiversity – distribution, abundance, ecological niche of bacteria and archae.</p> <p>2. Current status of microbes in the living world, Modern trends in Microbial taxonomy including RNA world; Salient features of bacteria according to the Bergey’s Manual of Determinative bacteriology. Morphology and ultra-structure of bacterial cell.</p> <p>3. General characters of Arhaea and Gram Positive and Gram Negative bacteria, Important genera of Gram Positive and Gram Negative bacteria Physiological and biochemical protocols for their identification, General characters of Cyanobacteria, their classification, ultrastructure and economic importance.</p> <p>4. :General characters, nomenclature, classification, morphology and ultrastructure of viruses; Capsid and their arrangement; Purification of viruses by adsorption, precipitation, enzymes, serological methods (haeme agglutination and ELISA). Assay of viruses (physical and chemical methods).</p> <p>5 Bacteriophages: Structure and life cycle patterns of T-even phages; one step growth curve; Bacteriophage typing; Structure of Cyanophages, Mycophages; General characters and structure of viroids, Satellites and prions.</p> <p>6. Prakash S. Bisen, Microbes-concepts and applications, Wiley-Blackwell. 2. J.D.S.Panwar, Fundamentals of Microbiology-S.R.S Pub 3. Willey J, Sherwood L. and Woolverton C. Prescott’s Microbiology. 4. Bisen, P.S. Microbes in Practices, I K international publication house pvt Ltd. 5. Sharma P.D. Microbiology, Rastogi publications 6. J.G.Black Microbiology, Wiley publication</p>
FM-104	<b>Metric Spaces</b>	1. General characteristics of eukaryotic



			<p>microbes; Ultrastructure and organization of a typical eukaryotic cell (membrane structure and functions, cytoskeleton, intracellular compartments- nucleus, mitochondria, chloroplast and their genetic organization); Structure and organization of chromatin; cell division.</p> <p><b>2.</b> Current status of fungi; organisms studied by mycologists; General characters, somatic structure, asexual and sexual reproduction of microbiologically,Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.</p> <p><b>3.</b> Mycotoxins, their identification and determination from food samples; Culture of microfungi from different food samples by damp chamber technique and their identification; examination of various solid and soft foods including water samples for fungal contamination by different cultural methods.</p> <p><b>4.</b> General characteristics of algae; Somatic structure, asexual and sexual reproduction of microbiologically important genera of Chlorophyceae, Phaeophyceae, Bacillariophyceae, Rhodophyceae and Dinophyceae. Culture of algal contaminations from various food and water samples; Economic importance of algae.</p> <p><b>5</b> General characteristics of Protozoans; Nematodes;Structure and reproduction of microbiologically important genera of protozoans (Entamoeba, Trichomonas, Leishmania, Trypanosoma, Plasmodium) and Nematodes: Ancylostoma, Ascarislumbricoides, Necator;Cestodes: Taeniasolium, Trematodes: Fasciola hepatica.</p> <p>6 1. Prakash S. Bisen, Microbes-concepts and applications, Wiley-Blackwell. 2. J.D.S.Panwar, Fundamentals of Microbiology-S.R.S Pub 3. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology. 4. Bisen, P.S. Microbes in Practices, I K international</p>
--	--	--	---

			<p>publication house pvt Ltd. 5. Sharma P.D. Microbiology, Rastogi publications 6. J.G.Black Microbiology, Wiley publication</p>
<b>II</b>	FM-201	<b>Food and Food Sources</b>	<p><b>1.</b> Food basics, food groups, food chain, food texture, food intake and its regulation, food and its functions as physiological, body buildings, psychological and social functions, food pattern, food consummation trends, population growth and food production</p> <p><b>2.</b> Food from plant sources, food grains, cereals and cereal products, composition of cereals, processing of cereals, Pulses and their nutritional value, processing of pulses, nuts and oilseeds, processing of oilseeds, other horticulture crops, post harvest processing of food crops.</p> <p><b>3.</b> Food from animal sources, meat and meat products, live stocks poultry and meat production, wholesome of meat production, processed meats, egg and egg products, milk and milk products, dairy by products, fish and fishery products</p> <p><b>4.</b> Organic foods, genetically modified food, energy drinks, stimulating drinks, carbonated non alcoholic beverages/soft drinks, comfort foods, infants foods, nutraceuticals, ayurvedic medicinal foods, food taboos.</p> <p><b>5.</b> Food industry, components and characteristics of the food industry, allied industries, international activities of food industry, processing and value addition, food trade, national food processing policy, food safety.</p> <p>6 1 . Nelson D and Cox MM., Lehninger's Principles of Biochemistry. W.H. Freeman and Company. 2. Voet D and Voet JG., Principle's of Biochemistry. John Wiley and sons New York. 3. Stryer. L. Biochemistry. W. H. Freeman and Co. 4. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology. 5. U. Satyanarayan Biochemistry, Elsevier 6. Andrew Proctor Alternatives to conventional food</p>

			processing, RSC pub. 7. Frazer WC and Westhoff DC. Food Microbiology. Mcgraw Hill, New York. 8. B.D. Singh. Biotechnology, Kalyani Publication. 9. Srilakshmi B Food Science, New Age Publication.
	FM-202	<b>FOOD MICROBIOLOGY</b>	<p><b>1.</b> Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; factors affecting food spoilage, different types of spoilage, food preservation.</p> <p><b>2.</b> Bio-deterioration of food items. Bacterial and mycotoxins, Important microbes secreting toxins, chemical nature of important toxins; their role in food poisoning; physiology and mechanism of action, control of toxin contamination.</p> <p><b>3.</b> Uses of microbes in meats and poultry products, vegetables etc. Use of microbial enzymes in food; low calorie sweeteners, Flavour modifiers; Food additives.</p> <p><b>4.</b> Microbiological examination of milk, standard plate count, direct microscopic count and reductase test, composition of milk, sources of contamination of milk, types of microbes in milk, pasteurization of milk, ability of milk to cause disease.</p> <p><b>5:</b> Common food borne pathogens, diseases caused by them and their symptoms, Disease caused by bacteria, molds and yeasts, viral contamination of foods, parasites, Surveillance system for tracking of food borne disease</p> <p>6 . Butt, TM, Jackson CW and Magan N. Fungi as Biocontrol agent. CABI Publishing, UK. 2. Adams Food Microbiology. 3. Prajapati Fundamentals of Dairy Microbiology. 4. John C, Ayres OM, William ES. Microbiology of Foods. W. H. Freeman and Co. 5. Andrew Proctor Alternatives to conventional food processing, RSC pub. 6. Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York.</p>
	FM-203	<b>FOOD</b>	<b>1.</b> Food chemistry, history, water

		<p><b>CHEMISTRY</b></p>	<p>structure and relations in food components, carbohydrates: monosaccharides, oligosaccharides and polysaccharides, starch and cellulose derivatives as food constituents, sugar and related products nutritional value, lipids: components, food lipids and health, antioxidants.</p> <p><b>2.</b> Proteins structure and functions, enzymes structure and functions, vitamins structure, types and functions, minerals and nutritional aspects, vegetables and fruits, bioavailability of nutrients.</p> <p><b>3.</b> Food oxidants, food pigments, natural and synthetic food colours, flavoring agents, sweeteners, emulsifiers and stabilizers, spices and herbs, food preservatives, organic foods, advantages and disadvantages of organic food, food fortification.</p> <p><b>4.</b> Food adulteration, types of adulteration: intentional adulteration, incidental adulteration, Food laws, food standardization and regulation agencies in India, national standards, international standards.</p> <p><b>5.</b> Evaluation of food quality, sensory tests, types of tests, objective evaluation and instruments used for texture evaluation.</p> <p>6 1. Voet D and Voet JG. Principle's of Biochemistry. John Wiley and sons New York. 2. Moat AG and Foster J. W. Microbial Physiology. John Wiley and Sons, New York. 3. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology, McGraw Hil 4. U. Satyanarayan. Biochemistry, Elsevier 5. Robinson Dairy Microbiology. 6. Jay JM Modern Food Microbiology. Van Nostraaand Reinhold Co., New York. 7. Andrew Proctor Alternatives to conventional food processing, RSC pub. 8. Frazer WC and Westhoff DC Food Microbiology. Mcgraw Hill, New York. 9. Srilakshmi B Food Science, New Age</p>
--	--	-------------------------	--

			Publication.
	FM-204	DAIRY TECHNOLOGY AND MICROBIOLOGY OF DAIRY PRODUCTS	<p><b>1.</b> Overview of Dairy industry, Basic functioning of Dairy plant (retention pond-irrigation, retention pond, second – stage lagoon, irrigation, vegetative filter, settling basin, vegetative filter, overland flow, distribution channelized terrace), Dairy industry in India, milk processing.</p> <p><b>2.</b> Fermented milk, yeast and lactic fermentation, mold lactic fermentation, natural Fermented Foods micro flora of dairy industry, pro-biotic products, functional food stuffs, industrial production of healthier food stuffs, modification of food tastes and healthier production, microbiological hazards in dairy industry</p> <p><b>3.</b> Dairy products types(concentrated and dried milk products), health risk of consuming dairy products, back drop of milk preservation methods, refrigeration, milk production level, breeding of milk animals, hormone use, nutrition, pesticide use.</p> <p><b>4.</b> Microbiology of spoilage of dairy products, types of spoilage microorganism, source of spoilage, factor affecting spoilage, prevention and control measure, method and detection .</p> <p><b>5-</b> Significance of milk and dairy products for humans, consumption of milk hygiene, contamination of milk with extraneous matter, starter culture, component of milk food.</p> <p>6 1. Butt, TM, Jackson CW and Magan N, Fungi as Biocontrol agent. CABI Publishing, UK. 2. Adams, Food Microbiology. 3. Prajapati, Fundamentals of Dairy Microbiology. 4. Robinson (Latest Edition). Dairy Microbiology. 5. Jay JM, Modern Food Microbiology. Van Nostraaand Reinhold Co., New York. 6. Andrew Proctor, Alternatives to conventional food processing, RSC pub. 7. Frazer WC and Westhoff DC, Food Microbiology. Mcgraw Hill, New York. 8. B.D. Singh, Biotechnology, Kalyani</p>

			Publication
	FM-301	Biostatistics, Computer Applications & Bioinformatics	<p><b>1.</b> Introduction to Biostatistics: Definition, Types of statistics, Applications and uses of Biostatistics, Identification and types of variable, Tabulation of data, Graphical presentation (categorical and metric data), charting of data using MS Excel; Sampling techniques; Frequency distribution; Measures of central tendency (mean, median and mode); Measures of dispersion: mean deviation and standard deviation; Correlation and regression.</p> <p><b>2.</b> Basic concepts related to probability theory, classical probability. Probability distributions: Introduction and simple properties of Binomial, Poisson, Normal and skewed distribution and their applications in biology. Sampling: Concept of sampling and sampling techniques;</p> <p><b>3.</b> Overview of computer systems: Introduction and classification; Components of computer; generation of computers; Number system; Flow chart; Basics for operating system (MS-DOS, WINDOWS, Unix and Linux); Introduction to softwares; MS-Office (MS-WORD, Power Point, MS- Excel).</p> <p><b>4.</b> Introduction to networking (LAN, WAN, MAN) servers, application of networking, Topologies (Bus Network, Ring Network, Star Network, Mesh Network, Tree Network) and their advantages &amp; disadvantages; Transmission Medias (Coaxial Cable, Fiber Optics, Twisted Pair); Internet, downloading files with anonymous FTP, Gopher, Mosaic.</p> <p><b>5.</b> Introduction to Bioinformatics, Role of Bioinformatics; Biological databases: Nucleic Acid Sequence Database, Protein Sequence Database and Protein Structure Database); obtaining BLAST Documentation and Help; Important bioinformatics websites (NCBI, EBI, SIB).</p>

			<p>6 1. Guigo R. Ed. &amp; Gusfield. Algorithm in Bioinformatics. O.Ed. Berlin. Springer-Verlog</p> <p>2. Sharma, Munjal and Shankar. A Text book of bioinformatics. Rastogi Publications.</p> <p>3. P.K. Sinha. 2016. Fundamental of computers. BPB publication.</p> <p>4. Ewens, W. J. &amp; Grant, G. R. Statistical methods in bioinformatics: an introduction. New York. Springer.</p> <p>5. S.C.Gupta &amp; V.K. Kapoor. Fundamentals of Applied Statistics Sultan Chand publication</p> <p>6. Ghosh, Subir. Statistical design and analysis of industrial experiments.</p> <p>7. David W. Mount, David Mount. Bioinformatics: Sequence and Genome Analysis.</p>
	FM-302	Food Processing, Preservation and Packaging	<p><b>1.</b> Introduction to food processing, food container manufacturing, food canning, food science and high processing techniques, shelf life of processed food, food processing of cereals, legumes, oil seeds, fruits and vegetables, dairy products, dairy processing biotechnology, membrane technology in dairy processing and fermentation, flesh food technology, food additives, extruded food, food radiation.</p> <p><b>2.</b> Introduction to preservation, types of preservation, natural and artificial preservative agent, class I, II and III preservative agents, methods of preservation, thermal process, Vacuum drying and dehydration, cooking and freezing, food preservation by chemicals, minimal processing of fresh foods,</p> <p><b>3.</b> Emerging techniques in food processing, modified atmosphere packaging, genetic engineering.</p> <p><b>4-</b> Emerging technologies for minimally processed fresh fruit juices, pulse electric field, high hydrostatic pressure.</p> <p><b>5-</b> Environmental aspects of food processing technology, food packaging wastes and its environmental aspects, environmental impact on packaging, food</p>

			<p>processing industry, safety in food processing,</p> <p>6 1. J. Scott Smith and Y.H. Hui., Food processing principles and applications. Blackwell publishing 2. B.S. Khatkar, Food Science and technology, Daya publishing house Delhi 3. Martin R Adams and Maurice O Moss Food Microbiology. The Royal Society of Chemistry. Cambridge UK 4. William C frazier, Dennis C Westhoff. Food microbiology. McGraw Hill Education private Limited New Delhi</p>
	FM-303	Food Laws and Standards	<p><b>1.</b> Introduction to food laws, Prevention of Food Adulteration Act (PFA1954), the preamble of Act, definition, primary food, kinds of adulteration in the Act, adulterated food, article held as court, misbranded food, functional responsibilities of various authority, central food laboratories, role of food inspectors</p> <p><b>2.</b> Food safety and quality requirements, voluntary requirement, legal requirement, mandatory provisions prescribed under PFA Act, 1954 and rules 1955, Enforcement of Prevention of Food Adulteration Act (PFA- 1954) by State Government, Ministries and Departments responsible for ensuring food safety and quality in India</p> <p><b>3.</b> Food Safety and Standards Act 2006 (FSSA-2006)- rules and regulations 2011, existing food laws in India, salient features of Food Safety and Standards Act 2006, Important provision of FSSA, Essential Commodities Act.</p> <p><b>4</b> Codex Alimentarius commission (CAC), Statutes of codex alimantrius commission, needs for harmonizing national standards with codex. WTO implication, SPS agreement, TBT agreement, relation between the codex and WTO, dispute settlement, other international standards setting bodies.</p> <p><b>5.</b> Customs Act and Import Control Regulation, other law related to food</p>



			<p>product (Legal metrology, provisions of Weight and Measure Act 1976, The Insecticides Act 1968, Consumer Protection Act 1986, Customs Act 1962</p> <p>6 1. Visit <a href="http://www.cfst-angrau.co.cc">http://www.cfst-angrau.co.cc</a> or <a href="http://www.cfst-bapatla.blogspot.com">http://www.cfst-bapatla.blogspot.com</a> for all Act, Order, Rules and other material.  2. Patricia and Curtis A, An operational Text Book, Guide to Food Laws and Regulations. 3. Ranganna S, Hand book of Analysis and Quality Control for Fruit and Vegetable Products. 4. Dev Raj, Rakesh Sharma and Joshi V.K, Quality for Value Addition in Food Processing. 5. The Food Safety and Standards act, along with Rules &amp; Regulations, Commercial Law Publishers (India) Pvt. Ltd.</p>
	FM-304	Principles of Food Safety	<p><b>1.</b> Introduction to food safety, hazards to safe food (chemical, biological, physical hazards), contamination and spoilage, food hygiene, food itself, people – safety of food, facilities and equipment, sources of contamination, primary production contamination, purchase, storage, production for packaging, distribution and delivery and service, food quality, food safety challenges, protection food from contamination (chemical, biological, physical hazards), reducing the effect of contamination; Role of food processing industries and sector.</p> <p><b>2.</b> History, back ground and structure of HACCP, Food chain steps, biological hazards, chemical hazards, physical hazards, history of HACCP, benefits and barriers in implementing HACCP, HACCP principles, HACCP prerequisites and good hygiene practice, Environmental hygiene, design and facilities in the establishment, equipment, utilities, control of operation, personal health and hygiene, pest control,</p> <p><b>3.</b> Principles and implementation of HACCP- Identification of hazards and control measures, determination of significant hazards, determination of critical control points, establishing the critical limits, Establishment of corrective</p>

			<p>action, establishment of verification procedure, establish documentation and record keeping, validation, general errors in HACCP plan, Quantitative approach in HACCP , implement of HACCP Plan, case studies of HACCP.</p> <p><b>4.</b> Introduction to risk analysis, risk management, Risk assessment, and Risk communication.</p> <p><b>5.</b> Other food safety practices- Good Agriculture practices, good animal husbandry practices, good manufacturing practices, good retail practices, good transport practices, nutritional labeling, Traceability studies.</p> <p>6 1. Adams MR and Moss MO, Food Microbiology RSC publications, UK. 2. Lightfoot NF and Maier EA (Editor), Microbiological analysis of food and water, Elsevier Publication, Netherland. 3. Ray B and Bhunia A, Fundamental food Microbiology CRCpublication, UK 4. B. Srilakshmi, Food Science New Age International Publisher, New Delhi 5. Martin R Adams and M J Robert Nout, Fermentation and Food Safety, Aspen Publication, Maryland. 6. Gilbert J., Food Packaging: Ensuring the safety and quality of Food, Publisher Taylor and Francis, Basingstake, Hants, UK</p>
	FM-401	PRINCIPLES OF FOOD QUALITY	<p><b>1.</b> Auditing: Scope of the standard terms &amp; definitions, internal audit, External audit, combined audit, Joint Audit. Principal of auditing, competence and evaluations of auditors, quality management principles. ISO 9001: 2000, quality management system, Clauses of ISO 9001: 2000.</p> <p><b>2.</b> Standardization and accreditation : Introduction, International accreditation forum (IAF), Internal Laboratory Accreditation Cooperation (IUAC), Quality Council of India (QCI), National Accreditation Board for Testing and Calibration Laboratories (NABL).</p> <p><b>3.</b> Quality Control &amp; Selection:</p>

			<p>Introduction, Legislative requirement, FSA surveillance, Laboratory accreditation and quality control, proficiency testing, Analytical methods: codex Alimentarius commission, European Union, other organizations.</p> <p><b>4. Pesticides:</b> Introduction, monitoring pesticides in food, high risk group, human exposure. <b>Mycotoxins:</b> Introduction, Health implications of mycotoxins application of HACCP system to control mycotoxins, preventions and control of mycotoxins.</p> <p><b>5. Radiation:</b> Safety of use of irradiated food, preservation of food by radiation, measurement of radiations, specific type of radiations treatment for safety of food, uses of radiations and prevention of food adulteration.</p> <p>6 1. Adams MR and Moss MO, Food Microbiology RSC publications, UK. 2. Lightfoot NF and Maier EA (Editor), Microbiological analysis of food and water, Elsevier Publication, Netherland. 3. Ray B and Bhunia A, Fundamental food Microbiology CRCpublication, UK 4. B. Srilakshmi, Food Science New Age International Publisher, New Delhi 5. Martin R Adams and M J Robert Nout, Fermentation and Food Safety, Aspen Publication, Maryland. 6. Gilbert J., Food Packaging: Ensuring the safety and quality of Food, Publisher Taylor and Francis, Basingstake, Hants, UK</p>
	FM-402	FERMENTATION TECHNOLOGY	<p><b>1.</b> Definition and scope of fermentation, basic design and operation of fermenter, microbial growth patterns and kinetics in batch culture, microbial growth parameters. Role of microbes in milk and dairy products,</p> <p><b>2.</b> General Principles of culture maintenance and preparation, bacterial culture, yeast culture and mold culture, properties of fermented foods, production of starter culture for dairy industries.</p> <p><b>3.</b> Food fermentation- bread, malt</p>

			<p>beverages, wines, distilled liquors, vinegar, fermented vegetables, production of cheeses, butter, yoghurt and fermented milk, oriental fermented foods.</p> <p><b>4.</b> Food and enzymes from microorganism, microbial biomass: single cell proteins and myco-protein, production of amino acids, and production of other substances added to foods, production of enzymes, fermented by-products</p> <p><b>5.</b> Benefits of fermentation, microbial activities in fermented food, control of microbial activities in fermented food, shelf life of fermented foods, and market of fermented food.</p> <p>6 1. Cruger, W. and AnnelieseCruger, A., Biotechnology, A text book of industrial Microbiology, Panima Publishers, New Delhi. 2. Casida, L.E., Industrial Microbiology, Willey Eastern Ltd, New Delhi. 3. Stanbury, P.F. and Whitaker, A., Principles of Fermentation Technology, Pergamon Press, Oxford. 4. Okafar, N., Modern Industrial Microbiology and Biotechnology</p>
	FM-403	Water And Food Borne Disease	<p><b>1.</b> Classification of food borne diseases, Food poisoning, infection, and intoxication, non bacterial toxins and mycotoxins Sea food toxicants. Poisoning by chemicals.</p> <p><b>2.</b> Major food and water borne bacteria S.aureus, Pseudomonas, Clostridium, Bacillus, Vibrio, E.coli, Salmonella, Shigella, Major food and water borne Viruses Polio virus, Rotavirus, SARS, Coronavirus, Enterovirus</p> <p><b>3.</b> Rapid methods for detecting microbial contaminants in foods, Interpretation and application of result and preventive measure</p> <p><b>4.</b> Irradiation replaces other food borne disease, microbiological aspect of food, transmission, symptoms, diagnosis, treatment, prevention of disease, Surveillance system for tracking food</p>

			<p>borne disease.</p> <p><b>5.</b> Natural waters: Sources of contamination, Microbial indicators of fecal pollution and other pollution, Elevated temperature test, IMViC test Water quality test.</p> <p>6 1. Marth, E.H. and Steele, J.L. Applied Dairy Microbiology, Marcel Dekker, Inc. New York 2. Frazer, W.C. and Westhoff, D.C. Food Microbiology, McGraw Hill, New York. 3. Willey, J., Sherwood, L. and Woolverton, C. Prescott's Microbiology, McGraw Hill, New York. 4. Murray, P.R., Tenover, F.C. and Tenover, M.A. Clinical Microbiology. ASM</p>
	FM-404	PUBLIC HEALTH ENGINEERING AND HYGIENE	<p>: <b>1.</b> Individual health parameters, Determinants of Health, Key health indicators, Burden of diseases, Importance and Source of Public-health Data Health status in India: Standards, Relevance to social aspects, Future challenges in public health.</p> <p><b>2.</b> Role of Public, Private and NGO in Health sector, Expenditure in Healthcare, Government Plans and Policies in India, The Global Health Council, The International AIDS Vaccine Initiative, Malaria Vaccine Initiative, World Health Organization (WHO).</p> <p><b>3</b> Overview of Healthcare Systems in India, Primary healthcare handwashing, immunization, circumcision, Secondary healthcare draining puddles of water, clearing bushes and using insecticides, Tertiary healthcare Hospital interventions intravenous rehydration and surgery, Family planning programs: Contraceptives, Sexuality education promotion of safe sex, Pregnancy risk, infant health.</p> <p><b>4.:</b> Microbiological analysis of food: Direct Microscopic examination of food, Cultural techniques, Enumeration method: Direct count by SPC (Standard plate count) and MPN (Most probable</p>

			<p>number) Count Physico-chemical method by Dye reduction test, Electrical methods, ATP determination.</p> <p><b>5.:</b>Food Safety Supervisor, Use of gloves, Effective hand washing, Home hygiene, Hygiene in the kitchen, bathroom and toilet, body hygiene, food hygiene, Medical Hygiene at home.</p> <p>6 1. Gordon Edlin and Eric Golanty Health &amp; Wellness Jones &amp;BarlettPublisher. 2. Skolnik Richard Global Health 101 Jones &amp;Barlett Learning 3. Mary-Jane Schneider Introduction to Public Health Jones &amp;Barlett 4. Geofferey Campbell-Platt Food Science and Technology, Willey andBlackwell Publication, UK. 5. Lightfoot NF and Maier EA Microbiological analysis of food and water,Elsevier Publication, Netherland.</p>
	FM-501	MICROBIAL GENETICS AND MOLECULAR BIOLOGY AND GENETIC ENGINEERING	<p><b>1.:</b> Nucleic acids as genetic information carriers: experimental evidences; DNA structure: historical aspects and current aspects, types of DNA, DNA replication in prokaryotes, steps: initiation, elongation, termination, types of polymerases, central dogma.</p> <p><b>2.:</b> Types and structural features of RNA (mRNA, tRNA, rRNA), transcription in prokaryotes and eukaryotes, genetic code, protein synthesis in prokaryotes and eukaryotes, Regulation of gene expression: operon concept, Lac operon, negative and positive regulation.</p> <p><b>3.:</b> Gene structure and functions, mutations, spontaneous and induced mutations, mutagens (physical mutagens: non ionizing radiation, chemical mutagens: base analogues, alkylating agents, deaminating agents, intercalating agents and others), DNA repair mechanisms, gene transfer mechanisms, transposable elements.</p> <p><b>4.:</b> Basics of r-DNA technology, enzymes used in r-DNA technology: DNA ligase, DNA polymerase, Klenow</p>

			<p>fragment, reverse transcriptase, exonuclease, endonuclease, terminal deoxynucleotidyltransferase, alkaline phosphatase, polynucleotide kinase, restriction enzymes and their types, gene libraries: genomic library, cDNA library.</p> <p><b>5.:</b> PCR and its applications, DNA sequencing methods: dideoxy and chemical methods, DNA finger printing, hybridization; general properties; plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes.</p> <p>6 1.David P Clark, Cell and Molecular Biology. 2. J.E. Krebs,Lewin's Genes X, Jones Pub. 3.T.A.Brown, Gene cloning of DNA Analysis. Wiley Blackwell. 4. J D Watson, Molecular biology. 5. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith, Becker's Word of the cell. 6. Gerald Karp, Cell Biology, Wiley Blackwell, Pub.</p>
	FM-502	NUTRITIONAL THERAPY	<p>1 Sources of Nutrition, Nutritional requirements of a healthy person, Therapeutic nutrition, Nutritional supplements, artificial nutrition, Enteral Nutrition, Parenteral Nutrition. Functional foods, types of functional foods, Nutraceuticals.</p> <p>2.: Use of Therapeutic nutrition in Nausea, Vomiting, Swallowing problems, Weight loss and related problems, Allergies, Food allergies, Diagnosis and intolerance, Dietary management of food allergies, Pea nut allergy, Cow milk allergy. Digestive disorders and diets.</p> <p>3.: Diabetes, types of diabetes, complications associated with diabetes, Therapeutic nutrition and management of diabetes; dietary fat and cholesterol, Renal/kidney conditions, kidney stones, eating the right amount of energy</p> <p>4.: Cancer, dietary factors associated with cancer, therapy and nutrition, nutritional side effects and dietary management, metabolic conditions of</p>

			<p>liver; Hepatitis, Cirrhosis, Gallbladder</p> <p>5.:Food for man: use of microbes and microbial enzymes in the improvement of nutritive quality of food, probiotics and Prebiotics, microbiological criteria for food, Fruit juices, Food control.</p> <p>6 1. Adams M. R. &amp; Moss M. O. Food Microbiology, Royal Society of Chemistry Publication, Cambridge.Pergamon Press. 2. Hobbs B. C. &amp; Roberts D. Food poisoning and Food Hygiene, Edward Arnold (A division of Hodder and Stoughton London). 3. Robinson R. K. Dairy Microbiology, Elsevier Applied Sciences, London. 4. Jones, S., Quinn S., Textbook of Functional Medicine. 5. Jonathan V. Wright (latest Edition) Dr Wright’s book of nutritional therapy 6. William C Frazier, Food Microbiology, McGraw Hill.</p>
	FM-503	ENVIRONMENTAL MICROBIOLOGY	<p>1. Environmental microbiology, historical perspectives, modern environmental microbiology, overall role of microbes in ecosystem, aeromicrobiology and aquatic microbiology, extremophiles.</p> <p>2 Soil microbiology, microbial diversity in surface soils, microbial decomposition of organic matters, microbial successions within and above the soil, biogeochemical cycles- C, N, S, P, etc.</p> <p>3 Microbiomics and microbial interactions, microflora of ruminants body, microbes-plant interactions, phyllosphere, rhizosphere, endophytes, mycorrhiza, biopesticides.</p> <p>4.: Microbial degradation, deterioration and bioremediation (oil spills), xenobiotics, biodegradation of xenobiotics (pesticides, polythenes), biocorrosion of metals, microbe–metal interactions (bioleaching, biomining, biohydrometallurgy), role of biosurfactants.</p> <p>5.: Microbes and water potability- purification of potable water, sanitary</p>



			<p>analysis of water (indicator microbes and methods of their detection), standards( tolerable levels) of water quality of faecal contamination, microbes in solid waste and sewage management (small scale and large scale), modern sewage treatment methods – oxidation ponds, trickling filters.</p> <p>6 1. Sharma, P.D. Environmental Microbiology, Rastogi Publications. 2. Prakash S. Bisen, Microbes in practice-I K international publication house pvt ltd. 3. Prakash S. Bisen, Microbes-concepts and applications Willey BlackWell Pub. 4. Forster CF and John DA, Environmental Biotechnology. Ellis Horwood Ltd. Publication. 6. Christon JH A Manual of Environment al Microbiology. ASM Publications. 7. Maier RM, Pepper IL and Gerba C.P., Environmental Microbiology. Academic Press. USA 8. Michel R. Introduction of Environmental Microbiology.</p>
	FM-504	FOOD PACKAGING AND MARKETING	<p>1. Introduction, need of food packaging, types of packaging, Forms of packaging.</p> <p>2. : Packaging material, CO.2 Flexible packaging material, Rigid packaging material, Semi-rigid packaging material, Modern packaging concept</p> <p>3 Modified atmosphere packaging for minimally processed foods, Active and intelligent packaging.</p> <p>4 : Labelling, Bar coding in packaging, packaging and environment, edible packaging of food, biodegradable plastics.</p> <p>5: History of food marketing, marketing mix, segmentation of food marketing, criticism, issues, food safety and public health.</p> <p>6 1. RaijaAhvenainen, Novel Food Packaging techniques; CRC Publication. 2. Shapiro, Nutrition Labelling Handbook (Food science and Technology); Publisher ; CRC 3. Packaging technology educational volumes, (Set –A), Indian Publications. 4. S. Natarajan, M. Govindarajan, B. Kumar. Fundamental of packaging technology.</p>

*Amg.*  
16.8.

*Amg.*

*Amg.*

