

SYLLABUS

M. Sc Food Microbiology & Toxicology

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY



• LUCKNOW •

प्रज्ञा शील करुणा
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Department of Environmental Microbiology

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M.Sc. (Food Microbiology & Toxicology)

Semester-I

Paper Code	Title of the Paper	Credits
FMT 101	General Microbiology of Food	06 (OP)#
FMT 102	General Food Chemistry, Microbial Physiology, Biochemistry & Genetics	06
FMT 103	Food Analysis, Instrumentation, Statistics and Bioinformatics	06
FMT 104	Practicals	06
FMT 105	Introduction to Food microbiology and General Techniques for Bacterial Isolation	06 (OP)*#

* For Choice Based Credit System

Students of M.Sc. Food Microbiology & Toxicology can opt either FMT 101 or FMT 105

Semester-II

Paper Code	Title of the Paper	Credits
FMT 201	Microbial Contamination, Preservation and Spoilage of different foods	06 (OP)#
FMT 202	Microbial Toxins and Food Protection	06
FMT 203	Food Toxicology and Waste Management	06
FMT 204	Practical	06
FMT 205	Microbial contamination and spoilage of food	06 (OP)#

* For Choice Based Credit System

Students of M.Sc. Food Microbiology & Toxicology can opt either FMT 201 or FMT 205

Semester-III

Paper Code	Title of the Paper	Credits
FMT 301	Microbial Food Products for Human Consumption	06
FMT 302	Food safety, Quality Control and Trade Regulation of Food Materials	06 (OP)#
FMT 303	Food Biotechnology and Food Quality Control act and Regulation	06
FMT 304	Practicals	06
FMT 305	Food Safety and Quality control Act	06 (OP)#

* For Choice Based Credit System

Students of M.Sc. Food Microbiology & Toxicology can opt either FMT 301 or FMT 305

Semester-IV

Paper Code	Title of the Paper	Credits
FMT 401	Dissertation work	24

M.Sc. (Food Microbiology and Toxicology) Syllabus

➤ I SEMESTER

○ **FMT 101: General Microbiology of Food (6 Credits) (Optional Paper)**

- **Unit I:** A brief history of microorganism in food, Scope of food Microbiology, Microbial diversity related with food, classification, cell morphology and ultra-structure of prokaryotic cell i.e. bacteria, viruses, actinomycetes, rickettsia and mycoplasma, eukaryotic cell i.e fungi, protozoans
- **Unit II:** General techniques for isolation, purification and characterization of bacteria, fungi, molds, different methods of sterilization, Gram staining.
- **Unit-III:** Nutritional requirement, type of nutrition in bacteria-autotrophs-phototrophs, chemotrophs, and heterotrophs-obligate and facultative parasite.
- **Unit-IV:** Bacteriological Media-Types of media, preparation of media, physical conditions required for bacterial growth-temperature, gaseous requirements, pH and miscellaneous physical requirements, Sample and enumeration of bacteria from water and food-Enumeration using different growth media, plating techniques, MPN method, P-A test, various media for *E. Coli*, Total coliform and coliform.

○ **FMT 102: General Food Chemistry, Microbial Physiology, Biochemistry & Genetics (6 Credits)**

- **Unit I:** Food chemistry definition, scope and importance of carbohydrate, protein, fat, amino acid, starch, gum & dietary fibers, vitamins in food, enzymatic & non-enzymatic browning reaction.
- **Unit II:** Biomolecules, structure and function, nucleic acid, metabolism of carbohydrates, glycolysis, citric acid cycle, gluconeogenesis, glyoxylate, phosphorylation, pentose- phosphate pathway, fermentation, transport of macromolecules across bacterial membrane.
- **Unit-III:** Bacterial growth cycle, pure culture and culture characteristics, maintenance and preservations of pure culture, intrinsic & extrinsic parameters of food that affect microbial growth.
- **Unit-IV:** Structure of DNA and RNA, replication of DNA, different types of plasmid and their function, transformation, transduction, conjugation, mutation, DNA repair mechanism, bacterial recombination, transposons.

○ **FMT 103: Food Analysis, Instrumentation, Statistics and Bioinformatics(6 Credits)**

- **Unit I:** Introduction to Food analysis, types of samples and sampling techniques, storage and preservation of samples, expression of results, proximate analysis of foods: principles of moisture, fat, protein, carbohydrate, crude fibres and vitamins.
- **Unit II:** Instrumentation in food analysis: principles, types and application of spectroscopy, photometry, electrophoresis, chromatography, atomic absorption spectrophotometry, PCR, ELISA and micro-array.
- **Unit III:** Chemical, biological and physical methods for determining microorganisms and their products in food, chemical methods – thermostable nuclease, Limulus lysate for endotoxins, Adenosine Triphosphate measurement, radiometry, fluorogenic chromogenic substrates, immunological methods-serotyping, fluorescent antibody, Radioimmunoassay, lux gene luminescence, Nucleic acid DNA probes, physical methods-biosensors, impedance, microcalorimetry .

- **Unit IV:** Concept of bioinformatics and its relation with molecular biology examples of related tools (FASTA, BLAST, BLAT, RASMOL), Biological information and databases (GENBANK, PubMed, PDB), public domain database for nucleic acid and protein sequences. Sequence analysis- computational methods, homology algorithms (BLAST) for proteins and nucleic acids, phylogenetic analysis, phylogenetic tree; Methods of data collection, sampling and sampling methods, measurements of central tendency, mean, median, mode, standard deviation, standard error, variance, co-relation and regression analysis, analysis of variance (ANOVA), test of significance, t-test, z-test and f-test

○ **FMT105: Introduction to Food microbiology and General Techniques for Bacterial Isolation(6 credits)Optional Paper (Open Credit System)**

Introduction to food microbiology, common bacterial and fungal species contaminants of food, Bacterial nutrition, Bacterial growth and Nutrition Basic techniques for bacterial isolation and purification, Sterilization of glassware for microbiological work, gram staining, Bacterial cell wall structure, flagella, bacterial cell component, MPN test, Total coliform, Fecal coliform.

➤ **II SEMESTER**

○ **FMT 201: Microbial Contamination, Preservation and Spoilage of different foods (6 Credits) (Optional Paper)**

- **Unit I:** Contamination of foods from natural habitat (green plants, fruits, animals, sewage, soil, water, air) and handling and processing. General principles underlying spoilage: causes of spoilage, classification of food based on spoilage, factors affecting kinds and number of microorganisms in food, factors affecting the growth of microorganisms in food. Chemical changes caused by microorganisms.
- **Unit II:** Contamination, preservation of cereals and cereal products, sugar and sugar products: Concept of antibiotics and biological control, secondary metabolites, properties of food spoilage Psychrotropes and Thermophiles.
- **Unit III:** Contamination, preservation and spoilage of meat and meat products, eggs and poultry, fish and other sea foods: preservation by use of heat, low temperature, irradiation, drying and preservatives.
- **Unit IV:** Contamination, preservation and spoilage of milk and milk products, spoilage of heated canned foods: causes of spoilage, appearance of the unopened container types of biological spoilage of canned foods, miscellaneous foods: Fatty foods, essential oils, Spices and other condiments, salt, nutmeats, other foods.

○ **FMT 202: Microbial Toxins and Food Protection (6 Credits)**

- **Unit I:** Microbial toxins (endotoxin and exotoxin) and toxoids, source and chemistry of microbial toxins in contamination of food grains and food products.
- **Unit II:** General principles of food protection: methods of food protection, asepsis, maintenance of anaerobic conditions, protection by use of high temperature : Thermal death time, heat resistance of microorganisms, determination of thermal death process, protection by use of low temperatures: Growth of microorganisms at low temperatures, effect of subfreezing and freezing temperatures on microorganisms.

- **Unit III:** Protection by drying: methods of drying, factors in the control of drying, microbiology of dried foods, food protection with modified temperature: definition, primary effect of CO₂ on microorganism, the safety of Map foods, spoilage of Map and vacuum packaged meats.
- **Unit IV:** Protection by food additives: the ideal antimicrobial protection, food additives, added preservatives, developed preservatives, protection by Radiation: Ultra Violet radiation, ionizing radiations, Gamma rays and Cathode rays, Microwave processing.

○ **FMT 203: Food Toxicology and Waste Management (6 Credits)**

- **Unit I:** Introduction to food toxicology: classification, dose, determination toxins in food, naturally occurring toxins from animals, bacterial and fungal and sea food sources. Food additives as toxicants: artificial colors, preservatives, sweeteners; toxicants formed during food processing such as nitrosamines, maillard reaction products acrylamide, benzene, heterocyclic amines and aromatic hydrocarbons and irradiation, risk of genetically modified food, food supplements, persistent organic pollutants.
- **Unit II:** Agricultural and industrial contaminants in foods: pesticides residues in fruits and vegetables metal contaminants in foods and their toxicity in human body; animal drug residues in food and water, dioxins and related compounds in food; metals such as lead, arsenic and mercury.
- **Unit III:** Introduction: types of waste generated; non-degradable wastes; food industrial wastes from fruit and vegetable processing industry, fish, meat and poultry and dairy industry. Utilization of waste: methods of utilizing wastes to make value added products; pectin, food colorants, antioxidants from fruit peels (citrus, mango, pomegranate), lycopene from tomato peels, enzymes from meat processing.
- **Unit IV:** General principle of biodegradation, biotransformation of industrial waste, Solid waste storage and disposal methods- land-filling, burial, incineration, recycling; standards for disposal of wastewater; physical wastewater treatment i.e. screening, racks, adsorption, sedimentation; chemical wastewater treatment i.e. adsorption, chemical precipitation, flocculation, oxidation process; biological wastewater treatment i.e. anaerobic process (Up flow Anaerobic Sludge Blanket (UASB), Fluidized bed reactor (FBR), hybrid reactors), aerobic lagoons, activated sludge process, trickling filter treatment process

○ **FMT 205: Microbial contamination and spoilage of food(6 credits)Optional Paper for Credit Based Choice System (CBCS)**

- Introduction to microbial contamination to food, different sources of food contamination in environment, common food pathogen causes health hazards, microbial toxins, food protection by different methods, different methods of food preservation, detection of food toxicants i.e. heavy metals, residual pesticides, industrial waste treatment methods i.e. activated sludge process, Upflow anaerobic sludge blanket (UASB) and trickling filter process.

➤ **III SEMESTER**

○ **FMT 301 Microbial Food Products for Human Consumption (6 Credits)**

- **Unit I:** History of Single Cell Protein (SCP); Microbial SCP production by bacteria, algae and mycoprotein from fungi for use as food and feed; SCP production process by using different substrates; properties and nutritional values; Industrially used SCP (Quoron, Pruteen); Advantage and disadvantages of SCP. Mushroom cultivation, harvesting and post harvesting; important edible mushroom sp.

- **Unit II:** Concept of probiotics, prebiotics, symbiotics and bioactive food; Production and composition of various probiotics; chemistry, metabolism and bioavailability of probiotics; Effect of probiotics on human health and potential application in risk reduction of diseases; genetically modified probiotics/prebiotics.
- **Unit III:** Alcoholic beverages- brief history of development of industrial process, production of beer (brewing) media (raw material used), process, maturation and carbonation. Types of beer (lager, pilsner, bock). Whiskeys- types and production, production of wine- media and raw material used, different types (sparkling wine, burned wine, cider, wine vinegar), vinegar. Production and application of various organic acid i.e. citric acid, fumaric acid, lactic acid, benzoic acid, gluconic acid, acetic acid. Production and application of microbial enzymes and vitamins.
- **Unit IV:** Introduction to fermenter; different types of fermenter and fermentation process- downstream processing and on-line monitoring of industrial fermentation process/products purification and recovery of food or nutrient; Bio-processing/food supplements from microbes, Food fermentation: Bread, Cheese, Vinegar, fermented Vegetables, fermented dairy products, fermented meat products- Sausage & their production methods.

○ **FMT 302 Food safety, Quality Control and Trade Regulation of Food Materials (6 Credits) (Optional Paper)**

- **Unit I:** Food sanitation, microbiological criteria and food safety, Food safety objectives (FSO), Bacteriology of Water supplies, Sewage in waste treatment and disposal, Indicators of food microbial quality and safety, some indicators of product quality- Coliforms, Enterococci, Bifidobacterium, Coliphages.
- **Unit II:** Bacterial Food-borne poisoning, infections and intoxication: bacterial with examples of infective and toxic types- *Clostridium*, *Salmonella*, *Shigella*, *Staphylococcus*, *Campylobacter*, *Listeria*, general control measures for prevention of food borne diseases.
- **Unit III:** Non-bacterial food-borne poisoning, infections and intoxication: mycotoxins, viruses, rickettsia, food-borne parasites, seafood toxicants, poisoning by chemicals, preventive measures.
- **Unit IV:** Microbiological quality standards of food, control and inspection, Enforcement and Govt. Regulatory practices and policies. FDA, EPA, HACCP, ISI; handling of recombinant product; Detection of various methods of food toxicity, Hazard analysis criteria control points (HACCP) system for food safety, HACCP principles, Application of HACCP principles.

○ **FMT 303 Food Biotechnology and Food Quality Control act and Regulation (6 Credits)**

- **Unit I :** Introduction to food biotechnology; basic principles of genetic engineering; improvement of the food crops by genetic engineering; genetically modified plants and animals for enhanced food production; safety of GM food crops. Protein engineering in food technology: methods, applications of protein engineering to produce glucose isomerase, Lactobacillus beta-galactosidase and peptide antibiotic nisin.
- **Unit II:** Transgenic plant foods: golden rice, Bt brinjal, maize, tomato, potato, soyabean etc. Intellectual property rights (IPR) issues, patent application procedure, copyright laws, transfer of copyrights, infringements, trademarks, objectives- rights and protection, biopiracy problems; effect of biotech foods on the food business of developing and developed countries.
- **Unit III:** Food Quality Protection Act (FQPA); FQPA requirement, impact; Food Safety Standards Act (FSSA)-The Prevention of Food Adulteration Act, 1954, The Fruit Products Order, 1955, The Meat Food Products Order, 1973, The Vegetable Oil Products (Control) Order, 1947, The Edible Oils Packaging (Regulation) Order, 1998, The Solvent Extracted Oil, De oiled Meal, and Edible Flour (Control) Order, 1967, The Milk and Milk Products Order, 1992,

Essential Commodities Act, 1955 (in relation to food); Different regulations, Codex, Food export control and certification.

- **Unit IV:** Good practices in food quality management, Introduction of Good laboratory practices (GLP) and its applications, Elements of GLP, OECD guidelines for GLP, National Accreditation Board for Testing and Calibration Laboratories (NABL).
- **FMT 305: Food Safety and Quality control Act (6 credits) Optional Paper for Credit Based Choice System (CBCS)**
- Microbiological quality standard of food, Various Govt. Enforcement act FDA, EPA and HACCP, Genetically modified food (GMO), Prevention of food adulteration act 1954, Meat food product order 1973, The milk and milk product order, Food export control and certification, Good laboratory practices (GLP), National accreditation Board for testing and calibration laboratories (NABL).

➤ **IV SEMESTER**

FMT 401 Dissertation work (24 Credits)