

# **ORDINANCES FOR**

## **3- year(six semesters)-Degree Course**



**B.Sc.**

**(Food Microbiology, Safety and Quality Control)**

**(under Self Finance Scheme)**

**From the session 2021-22**

**Department of Microbiology**

**Ch. Charan Singh University**

**Meerut**

## **Overview**

Food microbiology, safety and quality control is the basic requirement of public health and hygiene. Food microbiology is the necessary and essential requirement of every food industry. The consumers, retailers, manufacturers and regulators are greatly concerned about food safety and quality control/management. Changing global pattern of food production; international trade, technological advancement, public awareness and their expectations; health and hygiene; new Food Safety Act of Government of India and many other related factors have created huge demand for trained personnel in food microbiology, safety and quality control.

**B.Sc. (Food Microbiology, Safety and Quality Control)** has been designed after carefully going through the requirements of various industries like-Food, soft drink, beverages, and the requirements of Agricultural and Processed Food Products Export Development Authority (APEDA), Ministry of Commerce, Government of India and the newly developed concept of nutritional therapy. This programme is expected to meet the increasing requirements of human resources for food microbiology, safety and quality control/management professionals in agriculture and food sector.

### **Objectives of the Course:**

Main objective of the course is to prepare well qualified professionals for application of microbes in food industry, auditing of Food Safety and Quality control/management system in the country so that India may compete with developed countries in global food safety and quality requirements. It will also ensure consumer safety within and outside the country and will improve public health and reduce medical expenses.

### **Exit points:**

If a candidate leaves the course after one year (2<sup>nd</sup> semester), he/she shall be awarded UG Certificate in “Food Microbiology & Food Chemistry”. If a candidate drops out after completing two years (4<sup>th</sup> semester) of course, he/she will be awarded an additional “UG Diploma in Food Safety”. Full degree of B.Sc. (Food-Microbiology, Safety and Quality Control) shall be awarded only after completion of full three years (6<sup>th</sup> semester) courses including all practical and compulsory industrial training/project/thesis in last 6<sup>th</sup> semester.

## **ORDINANCES**

All rules for conduct of examination pattern, pass percentage and admissions shall be the same as for other undergraduate three year (6 semester) courses in the Faculty of Science on the University campus. Maximum marks given in the Table are only tentative and each course may be allotted different marks if necessary, as per other professional UG courses of the University. Internal and external examination shall be as indicated in the given Table. The pattern of internal assessment shall be decided by the Department however, it will mainly include tests, quizzes, seminars, term papers, group discussions and home assignments. In first semester internal practicals including a group of four papers will be carried out followed by single external practical per semester. A candidate will have to complete a project/training/thesis in the last 6<sup>th</sup> semester for a period 4 to 6 months. Project/Practical work related to testing of food samples may be completed either in the Department of Microbiology and/or in collaboration with other laboratories/industries if the adequate facilities are available there. Course Coordinator may identify and select the laboratories/industries/other institutes and may undergo any MOU if required. One of the supervisors for project work may be opted from outside the University/Institute/laboratory where the candidate shall complete the project work. After the completion of Project work /internship the candidate shall submit a detailed project report/thesis and will make an open presentation for 20-30 minutes. He will defend his/her experimental design, results and conclusions before the Board of Examiners, to be appointed by the competent body/officer of the University who shall be normally the Vice-Chancellor.

### **Number of seats and fee structure**

Initially there should be only 30 seats which may be altered depending upon the facilities available in the Department. Reservation shall apply as per the policy of the University for other Courses on the campus. This course is approved under self finance scheme of the University/State Govt. and annual tuition fee of Rs.37,500/- (Rs. Thirt seven thousand five hundred rupees only) is suggested which shall include the project fee if any. However, the fee structure may be altered by the University depending upon the resources available.

### **Eligibility for Admission**

Minimum eligibility for admission in this three year B.Sc. (Food-Microbiology, Safety and Quality Control) course shall be 10 + 2 (Biology / Agriculture), with 45% marks for Gen./OBC and 40% marks for SC/ST/PWD (40% disability).

### **Appointment of Examiners**

Course Coordinator is authorized to make a proposal of the examiners (both for theory and practical examination) in consultation with the members of Board of Studies either through telephonic conversation or through electronic media. Alternately, a meeting of Board of Studies may be convened.

# B.Sc. Food Microbiology, Safety and Quality Control

## COURSE STRUCTURE

Following course structure is approved. The Department shall be at liberty to change/alter the sequence of the courses depending upon the resources available.

S.N.	Code No.	Title of Course	Internal MM	External MM
<b>First Semester</b>				
1.	FM-101	Instrumentation	50	50
2.	FM-102	Microbial Techniques in Food & Water Industry	50	50
3.	FM-103	Microbial Diversity – Prokaryotes	50	50
4.	FM-104	Microbial Diversity – Eukaryotes	50	50
5.	FM-105	Practical	--	100
<b>Second Semester</b>				
6.	FM-201	Food and Food Sources	50	50
7.	FM-202	Food Microbiology	50	50
8.	FM-203	Food Chemistry	50	50
9.	FM-204	Dairy Technology and Microbiology of Dairy Products	50	50
10.	FM-205	Practical	--	100
<b>Third Semester</b>				
11.	FM-301	Biostatistics, Computer Applications & Bioinformatics	50	50
12.	FM-302	Food Processing, Preservation and Packaging	50	50
13.	FM-303	Food Laws & Standards	50	50
14.	FM-304	Principles of Food Safety	50	50
15.	FM-305	Practical	--	100
<b>Fourth Semester</b>				
14.	FM-401	Principles of Food Quality	50	50
15.	FM-402	Fermentation Technology	50	50
16.	FM-403	Water & Food Borne Disease	50	50
17.	FM-404	Public Health Engineering & Hygiene	50	50
18.	FM-405	Practical	--	100
<b>Fifth Semester</b>				
19.	FM-501	Microbial Genetics, Molecular Biology & Genetic Engineering	50	50
20.	FM-502	Nutritional Therapy	50	50
21.	FM-503	Environmental Microbiology	50	50
22.	FM-504	Food Quality Management Systems	50	50
23.	FM-505	Practical	--	100
<b>Sixth Semester</b>				
24.	FM-601	Project Report including Viva-voce	400	400
25.	FM-602	short questions including objective type	100	

## **Code FM-101: INSTRUMENTATION**

**Unit I-** Basic principle and functioning of industrial fermenter, scope, relevance and future of microbial biotechnology to mankind.

**Unit II-** Basic principles and applications of UV-Visible Spectrophotometer, pH meter, Flame photometer, Atomic Absorption Spectrophotometer, Oven, melting point apparatus,

**Unit III-** Chromatography (paper, thin layer, column, gel filtration, ion exchange, and affinity chromatography), HPLC, FPLC, basic principle and functioning of GC/LC/MS instrument.

**Unit IV-** 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.

**Unit V-** 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.

### **Suggested Readings (Latest Editions):**

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.

## **Code FM-102: MICROBIAL TECHNIQUES IN FOOD AND WATER INDUSTRY**

**Unit-I** –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.

**Unit II-** Investigation of food and water borne disease, objective of investigation, personals involved in the investigation, materials and equipments required on field investigation.

**Unit III-** 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

**Unit IV-** Detection of coli forms and indicator organism, most probable number, confirmed, completed test and membrane filter techniques for water.

**Unit V-** Detection of viral pathogen by real time PCR, PCR, Immuno assay, ELISA, and nucleic acid probes method.

### **Suggested Readings (Latest Editions):**

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 processing, RSC pub.
7. Frazer WC and Westhoff DC, Food Microbiology. Mcgraw Hill, New York.
8. B.D. Singh, Biotechnology, Kalyani Publication

## **Code FM-103: MICROBIAL DIVERSITY-PROKARYOTES**

**Unit I:**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.

**Unit II:** 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.

**Unit III:** 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.

**Unit IV:**General characters, nomenclature, classification, morphology and ultra-structure 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).

**Unit V:** 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.

### **Suggested Readings (Latest Editions):**

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 publication house pvt Ltd.
5. Sharma P.D. Microbiology, Rastogi publications
6. J.G.Black Microbiology, Wiley publication

## **Code FM-104: MICROBIAL DIVERSITY-EUKARYOTES**

**Unit I:** 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 genetic organization); Structure and organization of chromatin; cell division.

**Unit II:** Current status of fungi; organisms studied by mycologists; General characters, somatic structure, asexual and sexual reproduction of microbiologically, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

**Unit III:** 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.

**Unit IV:** 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.

**Unit V:** General characteristics of Protozoans; Nematodes; Structure and reproduction of microbiologically important genera of protozoans (*Entamoeba*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*) and Nematodes: *Ancylostoma*, *Ascaris lumbricoides*, *Necator*; Cestodes: *Taenia solium*, Trematodes: *Fasciola hepatica*.

### **Suggested Readings (Latest Editions):**

1. Chatterjee K.D. Parasitology, Calcutta publication.
2. David Greenwood Medical Microbiology.
3. Willey J, Sherwood L. and Woolverton C. Prescott's Microbiology.
4. J.G. Black Microbiology, Wiley publication
5. Lee. R. E. Phycology, Cambridge University Press, Cambridge.
6. Talaro K.P. & Talaro A. Foundations in Microbiology McGraw-Hill College Dimensi.

**Code FM-105 Practical (Group of 4 Papers) FM-101 to FM-104**

## **Code FM-201: FOOD AND FOOD SOURCES**

**Unit I:** 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 consumption trends, population growth and food production.

**Unit II:** 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.

**Unit III:** 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.

**Unit IV:** 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.

**Unit V:** 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.

### **Suggested Readings (Latest Editions):**

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 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.

## **Code FM-202: FOOD MICROBIOLOGY**

**Unit I-**Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; factors affecting food spoilage, different types of spoilage, food preservation.

**Unit II-**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.

**Unit III-** Uses of microbes in meats and poultry products, vegetables *etc.* Use of microbial enzymes in food; low calorie sweeteners, Flavour modifiers; Food additives.

**Unit IV-** 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.

**Unit V:**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.

### **Suggested Readings (Latest Editions):**

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. 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.

## **Code FM-203: FOOD CHEMISTRY**

**Unit I-** 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.

**Unit II:** proteins structure and functions, enzymes structure and functions, vitamins structure, types and functions, minerals and nutritional aspects, vegetables and fruits, bioavailability of nutrients.

**Unit III:**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.

**Unit IV:** Food adulteration, types of adulteration: intentional adulteration, incidental adulteration, Food laws, food standardization and regulation agencies in India, national standards, international standards.

**Unit V-** Evaluation of food quality, sensory tests, types of tests, objective evaluation and instruments used for texture evaluation.

### **Suggested Readings (Latest Editions):**

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 Publication.

## **Code FM-204: DAIRY TECHNOLOGY AND MICROBIOLOGY OF DAIRY PRODUCTS**

**Unit I-** 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.

**Unit II-** 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

**Unit III-** 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.

**Unit IV-** Microbiology of spoilage of dairy products, types of spoilage microorganism, source of spoilage, factor affecting spoilage, prevention and control measure, method and detection .

**Unit V-** Significance of milk and dairy products for humans, consumption of milk hygiene, contamination of milk with extraneous matter, starter culture, component of milk food.

### **Suggested Readings (Latest Editions):**

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 Publication

### **Code FM-205 Practical (Group of 4 Papers) FM-201 to FM-204**

## **Code FM-301: Biostatistics, Computer Applications & Bioinformatics**

**Unit I:** 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.

**Unit II:** 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;

**Unit III: 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).

**Unit IV:** Introduction to networking (LAN, WAN, MAN) servers, application of networking, Topologies (Bus Network, Ring Network, Star Network, Mesh Network, Tree Network) and their advantages & disadvantages; Transmission Medias (Coaxial Cable, Fiber Optics, Twisted Pair); Internet, downloading files with anonymous FTP, Gopher, Mosaic.

**Unit V:** 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).

### **Suggested Readings (Latest Editions):**

1. Guigo R. Ed. & Gusfield. Algorithm in Bioinformatics. O.Ed. Berlin. Springer-Verlog
2. Sharma, Munjal and Shankar. A Text book of bioinformatics. Rastogi Publications.
3. P.K. Sinha. 2016. Fundamental of computers. BPB publication.
4. Ewens, W. J. & Grant, G. R. Statistical methods in bioinformatics: an introduction. New York. Springer.
5. S.C.Gupta & V.K. Kapoor. Fundamentals of Applied Statistics Sultan Chand publication
6. Ghosh, Subir. Statistical design and analysis of industrial experiments.
7. David W. Mount, David Mount. Bioinformatics: Sequence and Genome Analysis.

## **Code- FM-302:Food Processing, Preservation and Packaging**

**Unit I-**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.

**Unit II-** 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,

**Unit III-** Emerging techniques in food processing, modified atmosphere packaging, genetic engineering.

**Unit IV-** Emerging technologies for minimally processed fresh fruit juices, pulse electric field, high hydrostatic pressure.

**Unit V-** Environmental aspects of food processing technology, food packaging wastes and its environmental aspects, environmental impact on packaging, food processing industry, safety in food processing,

### **Suggested Readings (Latest Editions):**

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

## **Code-FM 303: Food Laws and Standards**

**Unit I-** Introduction to food laws, Prevention of Food Adulteration Act (PFA-1954), 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

**Unit II-** 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

**Unit III-** 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.

**Unit IV-** Codex Alimentarius commission (CAC), Statutes of codex alimentarius 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.

**Unit V-** 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.

### **Suggested Readings (Latest Editions):**

1. Visit <http://www.cfst-angrau.co.cc> or <http://www.cfst-bapatla.blogspot.com> 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 & Regulations, Commercial Law Publishers (India) Pvt. Ltd.

## **Code-FM 304: Principles of Food Safety**

**Unit I-** 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.

**Unit II-** 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,

**Unit III-** 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.

**Unit IV-** Introduction to risk analysis, risk management, Risk assessment, and Risk communication.

**Unit V-** Other food safety practices- Good Agriculture practices, good animal husbandry practices, good manufacturing practices, good retail practices, good transport practices, nutritional labeling, Traceability studies.

### **Suggested Readings (Latest Editions):**

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

**Code FM-305 Practical (Group of 4 Papers) FM-301 to FM-304**

## **Code-FM 401: PRINCIPLES OF FOOD QUALITY**

**UNIT 1:** Auditing: Scope of the standard terms & 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.

**UNIT 2:** 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).

**UNIT 3:** Quality Control & Selection: Introduction, Legislative requirement, FSA surveillance, Laboratory accreditation and quality control, proficiency testing, Analytical methods: codex Alimentarius commission, European Union, other organizations.

**UNIT 4:** 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.

**UNIT 5:** 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.

### **Suggested Readings (Latest Editions):**

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

## **Code-FM 402 FERMENTATION TECHNOLOGY**

**Unit I** 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,

**Unit II** 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.

**Unit III** Food fermentation- bread, malt beverages, wines, distilled liquors, vinegar, fermented vegetables, production of cheeses, butter, yoghurt and fermented milk, oriental fermented foods.

**Unit IV** 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

**Unit V** 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.

### **Suggested Readings (Latest Editions):**

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.



## **Code FM-404: PUBLIC HEALTH ENGINEERING AND HYGIENE**

**Unit I:** 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.

**Unit II:** Role of Public, Private and NGO in Health sector, Expenditure in Health-care, Government Plans and Policies in India, The Global Health Council, The International AIDS Vaccine Initiative, Malaria Vaccine Initiative, World Health Organization (WHO).

**Unit III:** Overview of Healthcare Systems in India, Primary healthcare hand-washing, 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.

**Unit VI:** 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.

**Unit VII:** 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.

### **Suggested Readings (Latest Edition):**

1. Gordon Edlin and Eric Golanty Health & Wellness Jones & Barlett Publisher.
2. Skolnik Richard Global Health 101 Jones & Barlett Learning
3. Mary-Jane Schneider Introduction to Public Health Jones & Barlett
4. Geoffrey Campbell-Platt Food Science and Technology, Wiley and Blackwell Publication, UK.
5. Lightfoot NF and Maier EA Microbiological analysis of food and water, Elsevier Publication, Netherland.

## **Code FM-405 Practical (Group of 4 Papers) FM-401 to FM-404**

## **CODE FM 501: MICROBIAL GENETICS AND MOLECULAR BIOLOGY AND GENETIC ENGINEERING**

**Unit I:** 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.

**Unit II:** 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.

**Unit III:** 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.

**Unit IV:** 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.

**Unit V:** 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.

### **Suggested Readings (Latest Editions):**

1. David P Clark, Cell and Molecular Biolgy.
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.

## **CODE FM-502: NUTRITIONAL THERAPY**

**Unit I:** 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.

**Unit II:** 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.

**Unit III:** 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

**Unit IV:** Cancer, dietary factors associated with cancer, therapy and nutrition, nutritional side effects and dietary management, metabolic conditions of liver; Hepatitis, Cirrhosis, Gallbladder

**Unit V:** 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.

### **Suggested reading (Latest Edition):**

1. Adams M. R. & Moss M. O. Food Microbiology, Royal Society of Chemistry Publication, Cambridge. Pergamon Press.
2. Hobbs B. C. & 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.

## **CODEFM 503: ENVIRONMENTAL MICROBIOLOGY**

**Unit I:** Environmental microbiology, historical perspectives, modern environmental microbiology, overall role of microbes in ecosystem, aeromicrobiology and aquatic microbiology, extremophiles.

**Unit II:** 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.

**Unit III:** Microbiomics and microbial interactions, microflora of ruminants body, microbes-plant interactions, phyllosphere, rhizosphere, endophytes, mycorrhiza, biopesticides.

**Unit IV:** 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.

**Unit V:** 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 contamination, microbes in solid waste and sewage management (small scale and large scale), modern sewage treatment methods – oxidation ponds, trickling filters.

### **Suggested Readings (Latest Editions):**

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.

## **CODE FM 504: FOOD PACKAGING AND MARKETING**

**Unit 1:** Introduction, need of food packaging, types of packaging, Forms of packaging.

**Unit 2:** Packaging material, Flexible packaging material, Rigid packaging material, Semi-rigid packaging material, Modern packaging concept

**Unit 3:** 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.

### **Suggested Readings (latest edition):**

1. RajjaAhvenainen, 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.

**Code FM-505 Practical (Group of 4 Papers) FM-501 to FM-504**

**CODE FM- 601: PROJECT REPORT/THESIS INCLUDING VIVA-VOCE**

**CODE FM- 602: SHORT QUESTIONS INCLUDING OBJECTIVE TYPES**