

#### IV. DEPARTMENT OF FOOD MICROBIOLOGY AND SAFETY



Sr. No.	Course No.	Course title	Credits	Semester
1	FMS-111	General Microbiology	3 (2+1)	I
2	FMS-122	Food Microbiology	3 (2+1)	II
3	FMS-233	Industrial Microbiology	3 (2+1)	III
4	FMS-244	Food Safety and Microbial Standards	3 (2+1)	IV
5	FMS-355	Food Biotechnology	3 (2+1)	V
6	FMS-366	Food Plant Sanitation	3 (2+1)	VI
7	FMS-367	Quality Assurance and Certification	3 (2+1)	VI
		<b>Total Credits</b>	<b>21 (14+7)</b>	

**FMS-111**

**GENERAL MICROBIOLOGY**

**3 (2+1)**

## **Theory**

Evolution and scope of microbiology Microbial classification, nomenclature and identification, Taxonomic groups and General methods of classifying bacteria Microscopy and microscopes: Smears and staining Morphology and fine structure of bacteria, Cultivation of bacteria, nutritional requirements, Nutritional classification of bacteria, Phototrophs, chemotrophs, autotrophs and heterotrophs, Obligate parasites Bacteriological media, Growth of bacteria, Reproduction of bacteria, Introduction to fungi, algae and protozoa and virus Nutrient transport phenomenon: Passive diffusion, facilitated diffusion, Group translocation and active transport Mutations: Types of mutations, mutagenesis, Mutation rate, repair of mutations, Phenotypes of bacterial mutants and Designation of bacterial mutants Destruction of microorganisms: Physical agents and chemical agents, Chemotherapeutic agents and chemotherapy, Characteristics of antibiotics and Mode of action of antibiotics Pure culture: Methods of isolation of pure cultures, Maintenance and preservation of pure cultures and culture collections

## **Practical**

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi: Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria

## **Teaching Schedule - Theory with Weightages (%)**

<b>Number of Units</b>	<b>Topic</b>	<b>Per cent Covered</b>
1 – 2	Evolution and scope of microbiology	7
3 – 6	Microbial classification, nomenclature and identification, Taxonomic groups and general methods of classifying bacteria	12
7 – 9	Microscopy and microscopes: Smears and staining	9
10 – 14	Morphology and fine structure of bacteria, cultivation of bacteria, nutritional requirements, nutritional classification of bacteria, phototrophs, chemotrophs, autotrophs and heterotrophs, obligate parasites	16
15 – 17	Bacteriological media, growth of bacteria, reproduction of bacteria, introduction to fungi, algae and protozoa and virus	9
18 – 20	Nutrient transport phenomenon: passive diffusion, facilitated diffusion, group translocation and active transport	9
21 – 25	Mutations: types of mutations, mutagenesis, mutation rate, repair of mutations, phenotypes of bacterial mutants and designation of bacterial mutants	16
26 – 29	Destruction of microorganisms: physical agents and chemical agents, chemotherapeutic agents and chemotherapy, characteristics of antibiotics and	13

	mode of action of antibiotics	
30 – 32	Pure culture: methods of isolation of pure cultures, maintenance and preservation of pure cultures and culture collections	9
<b>Total</b>		<b>100</b>

### *Practical Exercises*

<b>Number of Units</b>	<b>Topic</b>	<b>Number of Experiment</b>
1.	Guidelines for safety in food microbiology laboratory work	1
2.	Introduction to equipments commonly used in microbiology laboratory	1
3.	Sterilization of glasswares used in microbiology laboratory	1
4.	Simple staining: monochrome straining and negative staining	1
5.	Differential staining: Gram's staining and spore staining	1
6.	Microscopy	1
7.	Measuring size of microorganisms by micrometry	1
8.	Preparation of culture media	2
9.	Dye reduction tests for microorganisms	1
10.	Isolation of microorganisms using streak plate method	1
11.	Isolation and enumeration of microorganisms using spread plate method	1
12.	Isolation and enumeration of microorganisms using pout plate method	1
13.	Effect of different factors on growth of microorganisms	1
14.	Microorganisms examination of water	2
<b>Total</b>		<b>16</b>

### **TEXT BOOK**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Microbiology	Pelczar, Chan and Krieg	5 <sup>th</sup> Ed. Tata McGraw-Hill Education, New Delhi.
2	Fundamentals of Microbiology	Jeffrey C.P.	Elsevier Publication, London 2017 ISBN-13: 978-1449688615
3	Basic Microbiology	Khuntia B.K.	Daya Publication, New Delhi 2001

### **REFERENCE BOOKS**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Microbiology: An Introduction	Gerard J. Tortora, Berdell R. Funke, Christine L. Case	12 <sup>th</sup> Ed. Prentice-Hall, NY, USA. 2014
2	Prescott's Microbiology	Willey, Sherwood and Christopher	9 <sup>th</sup> Ed. McGraw-Hill Higher Education, NY, USA. 1998

**FMS-122**

**FOOD MICROBIOLOGY**

**3 (2+1)**

## ***Theory***

Importance and significance of microbes in food science Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients etc and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances, Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods; Microbiology of cereal and cereal products Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods Microbiology of fruits and vegetables and canned foods Microbiology of sugar and sugar products and salts and spices Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products Food borne intoxications and infections, types of food involved, toxicity and symptoms, chemical properties, environmental conditions Food borne viruses: Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms

## **Practical**

Isolation of bacteria and molds from foods; Microbial examination of cereal and cereal products: Identification, isolation and confirmation; Microbial examination of vegetable and fruits: Identification, isolation and confirmation; Microbial examination of meat and meat products: Identification, isolation and confirmation; Microbial examination of fish and other sea foods: Identification, isolation and confirmation; Microbial examination of eggs and poultry: Identification, isolation and confirmation Microbial examination of milk and milk products: Identification, isolation and confirmation; Microbial examination of sugar, salts and spices; Microbial examination of canned products: Identification, isolation and confirmation; Determination and enumeration of pathogenic and indicator organisms in foods (Coliform/Enterococcus); Thermal death time determination; Detection of Salmonella from food sample Detection of coliforms from water by MPN method; Detection of Staphylococcus aureus from food sample

## **Teaching Schedule - Theory with Weightages (%)**

<b>Number of Units</b>	<b>Topic</b>	<b>Per cent Covered</b>
1 – 2	Importance and significance of microbes in food science	7
3 – 7	Microbial spoilage of foods Factors affecting kinds, numbers, growth and survival of microorganisms in foods, Intrinsic factors; pH, water activity, nutrients etc and Extrinsic factors: Relative humidity, temperature and gaseous atmosphere	13
8 – 12	Chemical changes caused by microorganisms: Changes in nitrogenous organic compounds, non-nitrogenous organic compounds, organic acids, other compounds, lipids, pectic substances, Contamination of foods; Sources of contamination, Genera of bacteria, Maintenance of anaerobic conditions; Asepsis, removal of microorganisms; Intermediate moisture foods;	16
13 – 14	Microbiology of cereal and cereal products	7
15 – 17	Microbiology of milk and milk products, meat and meat products, poultry and eggs, fish and other sea foods	9
18 – 19	Microbiology of fruits and vegetables and canned foods	7
20 – 21	Microbiology of sugar and sugar products and salts and spices	7
22 – 23	Shelf life: Calculation of shelf life, Shelf life requirements, deteriorative reactions, accelerated testing	7
24 – 26	Simulations of product: Package environment interaction, shelf life simulation for moisture, oxygen, and light sensitive products	9
27 – 29	Food borne intoxications and infections, types of food involved, toxicity and symptoms, chemical properties, environmental conditions	9
30 – 32	Food borne viruses: Polio, hepatitis A and E, noroviruses, rota viruses, prion diseases, types of food involved, toxicity and symptoms	9
<b>Total</b>		<b>100</b>

### *Practical Exercises*

<b>Number of Units</b>	<b>Topic</b>	<b>Number of Experiment</b>
1	Isolation of bacteria and molds from foods	1
2	Microbial examination of cereal and cereal products: Identification, isolation and confirmation	2
3	Microbial examination of vegetable and fruits: Identification, isolation and confirmation	1
4	Microbial examination of meat and meat products: Identification, isolation and confirmation	1
5	Microbial examination of fish and other sea foods: Identification, isolation and confirmation	1
6	Microbial examination of eggs and poultry: Identification, isolation and confirmation	1
7	Microbial examination of milk and milk products: Identification, isolation and confirmation	1
8	Microbial examination of sugar, salts and spices	1
9	Microbial examination of canned products: Identification, isolation and confirmation	2

10	Determination and enumeration of pathogenic and indicator organisms in foods ( <i>Coliform/Enterococcus</i> )	1
11	Thermal death time determination	1
12	Detection of <i>Salmonella</i> from food sample	1
13	Detection of <i>coliforms</i> from water by MPN method	1
14	Detection of <i>Staphylococcus aureus</i> from food sample	1
Total		16

### TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Food Microbiology	Frazier and Dennis	4 <sup>th</sup> Ed. Tata McGraw-Hill Education, New Delhi. 1987
2	Modern Food Microbiology	James M. Jay	6 <sup>th</sup> Ed. Aspen Publishers, Inc., Gaithersburg, Maryland, USA. 2002
3	Basic Food Microbiology	Banawart GJ	2nd Ed. AVI Publ. 1989
4	Essentials of Food Microbiology	Garbutt J	Arnold Heinemann, 1997
5	Fundamentals of Food Microbiology	Ray B	3 <sup>rd</sup> Edition, CRC Press, 2004

### REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Martin R. Adams and Maurice O. Moss	Food Microbiology	3 <sup>rd</sup> Ed., The Royal Society of Chemistry, Cambridge, UK. 2008
2	Basic Food Microbiology	George J. Banwart	2 <sup>nd</sup> Ed. Chapman & Hall, New York, USA. 1989

**Theory**

History of industrial microbiology; Primary and secondary metabolites produced by the microorganisms  
 Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work  
 Fermentation media, Industrial sterilization; Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals.  
 Types of fermentors Types of fermentations; Alcoholic beverages: types, production and quality;  
 Industrially important secondary metabolites; and microorganisms involved Probiotics: Industrially important secondary metabolites, their production and downstream processing, biopesticides, antibiotics, enzymes, exopolysaccharides, biopolymers, steroids, biomers; Importance, role in fermented foods, organisms involved, beneficial effects Bacteriocins and Nisin Production of microbial enzymes;  
 Downstream processing Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery. Microbial cell products i.e. Mushroom, SCP, Baker's yeast, blue green algae and spirulina Measures to improve yield of fermented products

**Practical**

Isolation and screening of citric acid/ amylase/protease/antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid; Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid; Standardization of physical factors for higher yields of citric acid; Isolation, identification of cultures producing bio-colours; Production, purification and estimation of beer/ ethanol  
 Production, purification and assay of fungal amylases/proteases/Lipase; Production and assay of nisin from lactic acid bacteria.

**Teaching Schedule - Theory with Weightages (%)**

Number of Units	Topic	% Syllabus Covered
1 – 2	History of industrial microbiology	7
3 – 4	Primary and secondary metabolites produced by the microorganisms	7
5 – 7	Screening of microorganisms; Preservation of microorganisms; Organizations involved in microbiological work	9
8 – 12	Fermentation media, Industrial sterilization; Fermentor: Components of a fermentor, parts of fermentors, peripheral parts and accessories, additional accessories and peripherals. Types of fermentors	16
13 – 15	Alcoholic beverages: types, production and quality; Types of fermentations; Industrially important secondary metabolites; and microorganisms involved	9
16 – 18	Probiotics: Importance, role in fermented foods, organisms involved, beneficial effects	9
19 – 20	Industrially important secondary metabolites, their production and downstream processing, biopesticides, antibiotics, enzymes, exopolysaccharides, biopolymers, steroids, biomers	7

21 – 22	Production of microbial enzymes; Downstream processing	7
23 – 27	Cell disruption methods: Mechanical disruption methods and non-mechanical disruption methods; Extraction; Purification; Concentration; Product recovery.	16
28 – 30	Microbial cell products i.e. Mushroom, SCP, Baker's yeast, blue green algae and spirulina	9
31 – 32	Oriental and traditional fermented foods; Measures to improve yield of fermented products	7
<b>Total</b>		<b>100</b>

### *Practical Exercises*

<b>Number of Units</b>	<b>Topic</b>	<b>Number of Experiment</b>
1.	Study of fermentor accessories	1
2.	Study of bacterial growth curve	1
3.	Isolation and screening of citric acid/ amylase/protease/antibiotic producing microbes, Production of citric acid/Lactic acid/ Acetic acid	3
4.	Purification of citric acid/Lactic acid/ Acetic acid and Estimation of citric acid/Lactic acid/ Acetic acid	2
5.	Standardization of physical factors for higher yields of citric acid	2
6.	Isolation, identification of cultures producing bio-colours	1
7.	Production of alcoholic beverage by fermentation	2
8.	Production, purification and estimation of beer/ ethanol	1
9.	Production, purification and assay of fungal amylases/proteases/Lipase	1
10.	Production and assay of nisin from lactic acid bacteria	1
11.	Production of polysaccharides	1
12.	Production of traditional fermented food	2
Total		16

### **TEXT BOOK**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Industrial Microbiology	Casida LE	Wiley, 1968
2	Industrial Applications of Microbiology	Rajvaidya N.	APH Publishing, 2006
3	Prescott & Dunn's Industrial Microbiology	G. Reed	4 <sup>th</sup> Ed. AVI Publishers, Connecticut, USA. 2004
4	Brewing Science and Practice.	Dennis EB,	Woodhead Publishing Ltd. Cambridge, England. 2004

### **REFERENCE BOOKS**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Modern Industrial Microbiology and Biotechnology	Nduka Okafor	Science Publishers, Enfield, New Hampshire, USA. 2004
2	Handbook of Indigenous Fermented Foods	Steinkraus KS	Marcel Dekker, 1996



**FMS-244 FOOD SAFETY AND MICROBIAL STANDARDS 3 (2+1)**

**Theory**

Hazards in food chain: physical, chemical and biological biological; Toxins in food: naturally occurring, bacterial and fungal Intrinsic toxins produced during processing and storage Metals as toxins: Sources, contamination, toxicity and elimination Pesticide residues as toxin: Chlorinated and non-chlorinated Permitted and non-permitted food additives as an amended Microbial standards of fresh and processed foods Risk assessment and management during food preparation

**Practical**

Estimation of Salmonella / Shigella / Staphylococcus from food samples; Estimation of Fungal toxins form food Samples.; (Different types of foods); Heavy metal detection (Lead); Isolation and identification of Listeria and E. coli; HACCP for food industries by taking few models; Study of National and International microbial quality standards; Visit to export oriented food processing industry; Microbial and chemical analysis of water

**Teaching Schedule - Theory with Weightages (%)**

Number of Units	Topic	Per cent Covered
1 – 5	Hazards in food chain: physical, chemical and biological	16
6 – 9	Toxins in food: naturally occurring, bacterial and fungal	13
10 – 12	Intrinsic toxins produced during processing and storage of food	9
13 – 16	Metals as toxins: Sources, contamination, toxicity and elimination	13
17 – 21	Pesticide residues as toxin: Chlorinated and non-chlorinated	16
22 – 25	Permitted and non-permitted food additives	13
26 – 28	Microbial standards of fresh and processed foods	9
29 – 32	Risk assessment and management during food preparation	13
	<b>Total</b>	<b>100</b>

### Practical Exercises

Number of Unit	Topics	No. of Experiments
1.	Estimation of Salmonella / Shigella / Staphylococcus from food samples	3
2.	Estimation of fungal toxins from different foods (Different types of foods)	2
3.	Detection of Lead	1
4.	Detection of <i>Bacillus cereus</i>	1
5.	Detection of <i>Campylobacter</i>	1
6.	Detection of <i>Escherichia coli</i> and coliforms	1
7.	Detection of <i>Listeria</i>	1
8.	Detection of <i>Salmonella</i>	1
9.	Detection of <i>Staphylococcus aureus</i>	1
10.	Detection of <i>Clostridium perfringens</i>	1
11.	HACCP for food industries by taking few models	1
12.	Study of National and International microbial quality standards	1
13.	Visit to food industry to study microbial safety	1
<b>Total</b>		<b>16</b>

### TEXT BOOK

Sr. No.	Name of Book	Author	Publisher
1	Handbook of Food Toxicology	Deshpande SS	CRC Press
2	Food Hygiene and Sanitation	Roday	Tata McGraw Hill Education, 2011
3	Principles of Food Sanitation	Marriot and Gravi	Springer, 2006
4	Food Safety and Toxicology	Vries JD	CRC Press, 1996
5	Food Safety: Theory and Practice	Knechtges PL	Jones and Bartlett Publishers, 2011

### REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Food Microbiology	Adams and Moss	Royal Society of Chemistry, 2015
2	The Safety of Foods	Graham HD	AVI Publishing 1968
3	Food Additive Toxicology	Maga	CRC Press, 1994
4	Food Safety Management: A Practical Guide for the Food Industry	Yasmine and Huub	Academic Press, 2013

Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes, Promoter enzymes Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction) Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes Biosensors: Classification and application in food industry Application of biotechnology in food, Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labelling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004

**Practical**

Chemical mutagenesis using chemical mutagens (Ethidium bromide); Determination of survival curves using physical and chemical mutagens; Isolation and analysis of chromosomal/genomic DNA from E. coli and Bacillus cereus; Separation of protoplast using cellulytic enzymes; Production of biomass from fruit and vegetable waste; Introduction of ELISA/Southern blot/DNA finger printing, etc; Agarose gel electrophoresis of plasmid DNA; Pesticide degradation by pseudomonas species

**Teaching Schedule - Theory with Weightages (%)**

<b>Number of Units</b>	<b>Topic</b>	<b>Per cent Covered</b>
1 – 4	Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses	12
5 – 8	Chemical nature of the genetic material, properties and functions of the genetic material, organization of the genetic material in bacteria, eukaryotes and viruses	13
9 – 13	Transcription and translation: RNA synthesis, types of RNA, genetic code; Mutation and DNA repair, mechanisms of repair of damaged DNA (photo reactivation, excision repair, recombination repair, SOS repair, mismatch repair), transposable elements, plasmids, types of plasmids, genetic recombination in bacteria, transformation, transduction, conjugation, regulation of gene expression in prokaryotes; Expression of foreign genes, Promoter enzymes	16
14 – 16	Recombinant DNA technology: Restriction enzymes, cloning vectors, cloning procedure, cloning of specific gene and their identification (colony hybridization, C-DNA, southern blotting, polymerase chain reaction)	9
17 – 20	Gene cloning: Production of identical cells, isolation and purification of insert DNA, isolation of vector DNA, construction of recombined DNA, introduction of recombined DNA into host cell, identification and selection of cells containing cloned genes	12
21 – 23	Biosensors: Classification and application in food industry	9
24 – 27	Application of biotechnology in food, Immobilization of enzymes: Arresting of cell in insoluble matrix, immobilized cell systems, cell attachment in a surface, aggregation, entrapment, containment, physical adsorption, covalent bonding, cross linking, entrapment into polymeric films, microencapsulation, large scale cell immobilization, uses and applications in industries	13
28 – 32	Ethical issues concerning GM foods: Testing for GMOs, current guidelines for production, release and movement of GMOs, labelling and traceability, trade related aspects, bio-safety, risk assessment, risk management, public perception of GM foods, IPR, GMO Act 2004	16
<b>Total</b>		<b>100</b>

### ***Practical Exercises***

Number of Units	Topic	Number of Lectures
1	Chemical mutagenesis using chemical mutagens (Ethidium bromide)	1
2	Determination of survival curves using physical and chemical mutagens	2
3	Production of biomass and enzymes from fruits and vegetable waste	2
4	Isolation and analysis of chromosomal/genomic DNA from <i>E. coli</i> and <i>Bacillus cereus</i>	2
5	Separation of protoplast using cellulytic enzymes	2
6	Production of biomass from fruit and vegetable waste	2
7	Introduction of ELISA/Southern blot/DNA finger printing, etc	2
8	Agarose gel electrophoresis of plasmid DNA	2
9	Pesticide degradation by pseudomonas species	2
Total		16

### **TEXT BOOK**

Sr. No.	Name of Book	Author	Publisher
1	Biotechnology - Expanding Horizons	B.D. Singh	Kalyani Publishers, New Delhi. 2014
2	Introduction to Molecular Biology and Genetic Engineering	Brandenberg, Dhlamini, Sensi, Ghosh and Sonnino	FAO, Rome Italy 2011
3	Industrial Microbiology: Fundamentals and Applications	Ashok Agarwal and Pradeep Parihar	Agrobios India, Jodhpur. 2005

### **REFERENCE BOOKS**

Sr. No.	Name of Book	Author	Publisher
1	Biotechnology and Food Processing Mechanics	Meenakshi Paul	Gene-Tech Books, New Delhi 2007
2	Molecular Biology of the Gene	James D. Watson	7 <sup>th</sup> Ed. Benjamin Cummings, San Francisco, USA. 2013
3	Principles of Gene Manipulation and Genomics	S.B. Primrose and R.M. Twyman	7 <sup>th</sup> Ed. Blackwell Publishing, Victoria, Australia 2006

**Theory**

Good manufacturing practices and current good manufacturing practices Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures and role of pest management in bio-security Relationship of microorganisms to sanitation, Food contamination and protection against contamination Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal and liquid waste disposal Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides and integrated pest management Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations and pest control design Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials and cleaning of low-moisture food manufacturing plants Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures and evaluation of sanitation effectiveness

**Practical**

Estimation of BOD (Biological Oxygen Demand); Estimation of COD (Chemical Oxygen Demand); Determination of hardness of water; Good Manufacturing Practices (GMPs) and personal hygiene; Sewage treatment: Primary, secondary, tertiary and quaternary and Aerobic and anaerobic sludge treatment; Lab demonstration on state of water; Study of CIP plant; Isolation and identification of Actinomycetes; Enrichment and isolation of cellulose degrading bacteria; Biodegradation of phenol compounds; Bacteriological examination of water: Coliform MPN test; Sampling of airborne microorganisms, Sampling of surfaces - equipment and physical plant; Aerosol sampling and measurement guidelines

**Teaching Schedule - Theory with Weightages (%)**

Number of Units	Topic	Per cent Covered
1	Good manufacturing practices and current good manufacturing practices	2
2 – 6	Sanitation and the food industry: Sanitation, sanitation laws and regulations and guidelines, establishment of sanitary, potential risks of food borne bioterrorism, bioterrorism protection measures and role of pest management in bio-security	16
7 – 9	Relationship of microorganisms to sanitation, Food contamination and protection against contamination	9
10 – 13	Personal hygiene and sanitary food handling: Role of HACCP in sanitation, quality assurance for sanitation cleaning compounds, handling and storage precautions	13

14 – 16	Sanitizers, sanitizing methods, sanitation equipment, waste product handling, solid waste disposal and liquid waste disposal; Soil types and properties of cleaning agents.	9
17 – 19	Pest control: Insect infestation, cockroaches, insect destruction, rodents, birds, use of pesticides and integrated pest management	9
20 – 23	Sanitary design and construction for food processing: Site selection, site preparation, building construction considerations, processing and design considerations and pest control design	13
24 – 28	Low-moisture food manufacturing and storage sanitation: Sanitary construction considerations, receipt and storage of raw materials and cleaning of low-moisture food manufacturing plants	16
29 – 32	Fruit and vegetable processing plant sanitation: Contamination sources, sanitary construction considerations, cleaning considerations, cleaning of processing plants, cleaners and sanitizers, cleaning procedures and evaluation of sanitation effectiveness	13
<b>Total</b>		<b>100</b>

### *Practical Exercises*

Number of Units	Topic	Number of Lectures
1	Estimation of BOD (Biological Oxygen Demand)	1
2	Estimation of COD (Chemical Oxygen Demand)	1
3	Determination of hardness of water	1
4 – 5	Good Manufacturing Practices (GMPs) and personal hygiene	2
6 – 8	Sewage treatment: Primary, secondary, tertiary and quaternary and Aerobic and anaerobic sludge treatment	3
9	Microbial quality of water	1
10	Study of CIP plant	1
11	Isolation and identification of Actinomycetes	1
12	Enrichment and isolation of cellulose degrading bacteria	1
13	Biodegradation of phenol compounds	1
14	Bacteriological examination of water: Coliform MPN test	1
15	Sampling of airborne microorganisms, Sampling of surfaces - equipment and physical plant	1
16	Aerosol sampling and measurement guidelines	1
<b>Total</b>		<b>16</b>

**TEXT BOOK**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Principles of Food Sanitation	Marriot and Gravi	Springer, 2006
2	Food Hygiene and Sanitation	Roday S.	McGraw Hill Education, 2011
3	Essentials of Food Sanitation	Marriot N.	Springer 1997

**REFERENCE BOOKS**

<b>Sr. No.</b>	<b>Name of Book</b>	<b>Author</b>	<b>Publisher</b>
1	Biotechnology - Expanding Horizons	B.D. Singh	Kalyani Publishers, New Delhi. 2014
2	Biotechnology and Food Processing Mechanics	Meenakshi Paul	Gene-Tech Books, New Delhi 2007
3	Molecular Biology of the Gene	James D. Watson	7 <sup>th</sup> Ed. Benjamin Cummings, San Francisco, USA. 2013
4	Principles of Gene Manipulation and Genomics	S.B. Primrose and R.M. Twyman	7 <sup>th</sup> Ed. Blackwell Publishing, Victoria, Australia 2006



**Theory**

Introduction to Quality: Defining quality, Dimensions of quality, Quality control & quality assurance, Quality Gurus' Contribution Total Quality Management: Objectives, principles, implementation; Deming's 14 points on TQM, Benefits of TQM, Quality Tools, Quality Circle Other Management Philosophies: 5S, Six sigma, Lean manufacturing, Just-In-Time (JIT), Kanban International Organization for standardization (ISO): Introduction, ISO standards, benefits, procedure, generic management systems. ISO 9000, PRP for Food Safety: GAP – objectives, principles, benefits; GLP – need, history, objectives, principles, bodies; GHP – objectives, principles; GMP – objectives, GMP in food industry HACCP: Introduction, History of HACCP, Definitions related to HACCP system, Principles of HACCP, application of HACCP system, implementation steps for HACCP system, Benefits of HACCP ISO 22000: Introduction, History, benefits, Objectives, ISO 22000 family of standards series, ISO standard document, Role of BIS in ISO 22000 GFSI, FSSC 22000, IFS, SQF, AIB, GRMS, PAS 96 Accreditation and Certification: Introduction, Benefits, accreditation organizations, Certification, Types of certifications, Certification Bodies in India, BIS, AGMARK Documentation Auditing and Surveillance: Introduction, Definition, Objectives of auditing, Types of Audit, Principles of Auditing, Audit Program Procedures, Audit Activities, Audit Competencies, Lead Auditor, Surveillance. Recent Update on the subject (if any).

**Practicals**

Activities of Quality Department; Writing Standard Operating Procedures; Preparation of quality policy & documentation (quality Manuals); Application of HACCP to products.; Implementation procedure of ISO 22000; Preparation of documentation and records; Auditing- surveillance, mock audit.; Visit to units with GMP, ISO, HACCP certified plants

**Teaching Schedule - Theory with Weightages (%)**

Number of Units	Topic	Per cent Covered
1-2	Introduction to Quality: Defining quality, Dimensions of quality, Quality control & quality assurance, Quality Gurus' Contribution	6
3-5	Total Quality Management: Objectives, principles, implementation; Deming's 14 points on TQM, Benefits of TQM, Quality Tools, Quality Circle	10
6-7	Other Management Philosophies: 5S, Six sigma, Lean manufacturing, Just-In-Time (JIT), Kanban	6
8-10	International Organization for Standardization (ISO): Introduction, ISO standards, benefits, procedure, generic management systems. ISO 9000,	10
11-14	PRP for Food Safety: GAP – objectives, principles, benefits; GLP – need, history, objectives, principles, bodies; GHP – objectives, principles; GMP –	12

	objectives, GMP in food industry	
15-18	HACCP: Introduction, History of HACCP, Definitions related to HACCP system, Principles of HACCP, Application of HACCP system, Implementation steps for HAACP system, Benefits of HACCP	12
19-21	ISO 22000: Introduction, History, Benefits, Objectives, ISO 22000 family of standards series, ISO standard document, Role of BIS in ISO 22000	10
22-26	GFSI, FSSC 22000, IFS, SQF, AIB, GRMS, PAS 96	16
27-28	Accreditation and Certification: Introduction, Benefits, accreditation organizations, Certification, Types of certifications, Certification Bodies in India, BIS, AGMARK	6
29	Documentation	3
30-32	Auditing and Surveillance: Introduction, Definition, Objectives of auditing, Types of Audit, Principles of Auditing, Audit Program Procedures, Audit Activities, Audit Competencies, Lead Auditor, Surveillance. Recent Update on the subject (if any)	9
<b>Total</b>		<b>100</b>

### *Practical Exercises*

Number of Units	Topic	Number of Experiment
1	Activities of Quality Department	1
2	Studies on bar codes	1
3	Writing Standard Operating Procedures	2
4	Preparation of quality policy & documentation (quality Manuals)	1
5	Application of HACCP to products	2
6	HACCP Plan for Fruits and Vegetables	1
7	Implementation procedure of ISO 22000	1
8	Preparation of documentation and records	2
9	Auditing- surveillance, mock audit	2
10	Visit to units with GMP, ISO, HACCP certified plants	3
<b>Total</b>		<b>16</b>

### **TEXT BOOKS**

Sr. No.	Name of Book	Author	Publisher
1	Quality Assurance for Food Industry – A Practical Approach	J. Andres Vasconcellos	CRC Press Boca Raton [ISBN: 9780849319129]
2	Food Quality Assurance – Principles and Practices	Inteaz Alli	CRC Press Boca Raton [ISBN: 9780203484883]
3	HACCP User’s Manual	Corlett D.A.	An Aspen Publication, Maryland
4	Total Quality Assurance for the	Gould W.A. and	CTI Publication – Technology and

	Food Industry	Gould W.B.	Engineering
5	Food Industry Quality Control Systems	Mark Clute	CRC Press, Boca Raton [ISBN: 978-0-8493-8028-0]
6	Guide to Quality Management Systems for Food Industries	Early R.	Blackie Academic. 1995

## REFERENCE BOOKS

Sr. No.	Name of Book	Author	Publisher
1	Manual of Food Quality Control: Quality assurance in the food control microbiological laboratory	FAO	FAO Publication
2	HACCP and ISO 22000 – Application to Foods of Animal Origin	Arvanitoyannis I.S.	Wiley-Blackwell Publication Oxford [ISBN: 978-1-4051-5366-9]
3	Food Safety Management and ISO 22000 – Food Industry Briefing	Early Ralph	Food Industry Briefing Publication [ISBN: 9781405193245]
4	ISO 22000: Food Safety Management Systems Requirements for Any Organization in the Food...	ISO	International Organization for Standardization
5	HACCP, GMP and ISO 22000 – Overview	---	Institute of Workforce Education Saint Augustine College Publication [ISBN: 9781633051485]
6	HACCP – A Food Industry briefing	Mortimore S.E. and Wallace C.A.	Wiley Blackwell New York ISBN: 978-1-118-42723-1
7	Quality Management Essentials	Hoyle David	Elsevier Publication Oxford, UK [ISBN: 9780750667869]
8	Sensory Evaluation of Foods	Piggot JR	Elbview applied Science, 1984

