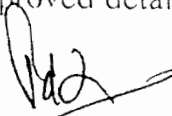


DEPARTMENT OF MICROBIOLOGY
CH. CHARAN SINGH UNIVERSITY
MEERUT

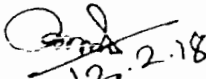
As per letter no. Committee Cell (BOS-Micro)3560 dated 05-02-2018, a meeting of the **Board of Studies in B.Sc. Food Microbiology, Safety & Quality Control** was held at 10:00 a.m. on 12-02-2018 in the Department of Microbiology to finalize the syllabus and ordinances for B.Sc. (Food Microbiology, Safety & Quality Control) under the University Campus *w.e.f.* the session 2017-2018. Following members were present:

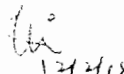
1. Prof. Y. Vimala, Dean & Head, Department of Microbiology, C.C.S. University, Meerut.
2. Professor P.D. Sharma, Ex-Professor of Delhi University, 72 Suncity, Meerut. Subject expert & V.C. nominee
3. Professor V.P. Singh, Ex-Professor of Delhi University, Delhi. Subject expert & V.C. nominee
4. Professor A. P. Garg, Former Coordinator, Currently Pro V.C. Jaipur National University Jaipur (Special Invitee).

The Committee went through the course contents and the Ordinances of 3 year course of **B.Sc. (Food Microbiology, Safety & Quality Control)** and approved detailed course contents of the same *w.e.f.* the session 2017-2018.


(P.D. Sharma)


(V.P. Singh)


12.2.18
(Amar P. Garg)


12/2/18
Y. Vimala)

Subject Expert

Subject Expert


Special Invitee

Dean & Head

For kind perusal and approval

Approved

(Vice-Chancellor)


13.2.18

BSc (Food Microbiology)

COURSE STRUCTURE

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

| S.N. | Code No. | Title of Course | Maximum Marks |
|--------------------|----------|---|---------------|
| First Year | | | |
| 1. | FM-101 | Instrumentation (A) | 50 |
| 2. | FM-102 | Microbial Techniques in Food & Water Industry (A) | 50 |
| 3. | FM-103 | Microbial Diversity – Prokaryotes (B) | 50 |
| 4. | FM-104 | Microbial Diversity – Eukaryotes (B) | 50 |
| 5. | FM-105 | Food and Food Sources (C) | 50 |
| 6. | FM-106 | Food Microbiology (B) | 50 |
| 7. | FM-107 | Food Chemistry (C) | 50 |
| 8. | FM-108 | Dairy Technology and Microbiology of Dairy Products (C) | 50 |
| 9. | FM-109 | Biostatistics, Computer Applications & Bioinformatics (A) | 50 |
| 10. | FM-110 | Practical based on A, B, C (Each Practical is of 50 marks) | 150 |
| Second Year | | | |
| 11. | FM-201 | Food Processing & Preservation (B) | 50 |
| 12. | FM-202 | Food Laws & Standards (A) | 50 |
| 13. | FM-203 | Principles of Food Safety (A) | 50 |
| 14. | FM-204 | Principles of Food Quality (A) | 50 |
| 15. | FM-205 | Fermentation Technology (B) | 50 |
| 16. | FM-206 | Water & Food Borne Disease (C) | 50 |
| 17. | FM-207 | Public Health Engineering & Hygiene (C) | 50 |
| 18. | FM-208 | Microbial Genetics, Molecular Biology & Genetic Engineering (C) | 50 |
| 19. | FM-209 | Nutritional Therapy (B) | 50 |
| 20. | FM-210 | Practical based on A, B, C (Each Practical is of 50 marks) | 150 |
| Third Year | | | |
| 21. | FM-301 | Environmental Microbiology | 50 |
| 22. | FM-302 | Food Quality Management Systems | 50 |
| 23. | FM-303 | Food Packaging & Marketing | 50 |
| 24. | FM-304 | Practical | 150 |
| 25. | FM-305 | Project Report | 300 |

NOTE: A candidate will have to complete a project/training work in the third year.

11-0

CH. CHARAN SINGH UNIVERSITY, MEERUT



Ref.: Committee Cell (BOS-Micro.)/356

Dated: 05-02-2018

A meeting of the Board of Studies (University Campus & Affiliated Colleges) in the subject of Microbiology will be held on 12-02-2018 at 10.00 A.M. in Department of Microbiology, Chaudhary Charan Singh University, Meerut. Members are requested to kindly find it convenient to attend the meeting please. Agenda of the meeting will be placed on table.

Members of Board of Studies in Microbiology :-

1. Prof. Y. Vimala, Dean & Head, Department of Microbiology, C.C.S. University, Meerut.
(Convener)
2. Prof. P.S. Bisen, Subject expert, Former V.C. Jiwaji University, Gwalior.
3. Prof. P.D. Sharma, Subject expert, Retired Professor Delhi University, Delhi.
4. Prof. V.P. Singh, Subject Expert, Retired Professor, Delhi University Delhi.
5. Prof. A.P. Garg, Former Co-ordinator, Currently Pro-V.C. Jaipur National University, Jaipur. (Special Invitee)

Registrar

Copy to:-

1. S.V.C. for kind information of the Hon'ble Vice Chancellor.
2. P.A. to Pro. V.C. for kind information of the Pro. V.C.
3. Steno to the Finance Controller for information of the Finance Controller to make arrangement of payment of TA/DA of participant and to expedite the bills of refreshment will be submitted by the concerned.
4. H.O.D. concerned/committee cell to make arrangement of refreshment e.t.c. to the members.

Registrar

DEPARTMENT OF MICROBIOLOGY
CH. CHARAN SINGH UNIVERSITY
MEERUT

As per letter no. Committee Cell (BOS-Micro)/3560 dated 05-02-2018, a meeting of the **Board of Studies in Microbiology** was held at 10:00 a.m. on 12-02-2018 in the Department of Microbiology to finalize the syllabus and ordinances for M.Sc. (Microbiology) under **Choice Based Credit System** for the University Campus *w.e.f.* the session 2017-2018. Following members were present:

1. Prof. Y. Vimala, Dean & Head, Department of Microbiology, C.C.S. University, Meerut.
2. Professor P.D. Sharma, Ex-Professor of Delhi University, 72 Suncity, Meerut. Subject expert & V.C. nominee
3. Professor V.P. Singh, Ex-Professor of Delhi University, Delhi. Subject expert & V.C. nominee
4. Professor A. P. Garg, Former Coordinator, Currently Pro-V.C. Jaipur National University Jaipur (Special Invitee).

The Committee went through the course contents and the Ordinances of 2 year course of **M.Sc. (Microbiology)+ 2 Elective** and approved detailed course contents of the same *w.e.f.* the session 2017-2018 under **Choice Based Credit System**.




(P.D. Sharma)

Subject Expert



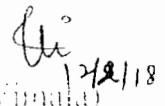
(V.P. Singh)

Subject Expert


12.2.18

(Amar P. Garg)

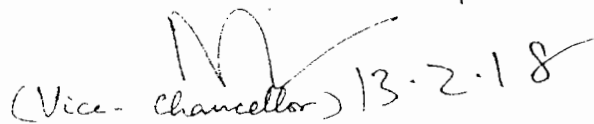
Special Invitee


12/2/18

(Y. Vimala)

Dean & Head

For kind perusal and approval


(Vice-Chancellor) 13.2.18

ORDINANCES FOR

2- year Post-graduate Course


M.Sc. Microbiology
(under Choice Based Credit System)

From the session 2016-17

Department of Microbiology
Ch. Charan Singh University
Meerut






12/02/2018



OVERVIEW

In view of the increasing demand of competent microbiologists, this four semester (two year) course of M.Sc. (Microbiology) has been designed to train the student with different fields of microbiology technology. In first three semesters, the student will study all courses of Microbiology and in final fourth semester, he/she will have an option to select any two of the four Electives offered by the Department. Besides two Electives, the student will also have a choice of two optional open electives which he can study in any of the regular Departments of University Campus. The course contents are designed in such a way that the student may either pursue his career as an academician or may secure jobs in pharmaceutical industry, food industry, agricultural sector, environmental pollution control departments and quality control industries *etc.*

AIMS

We aim to give a significant level of theoretical and practical understanding in four specialized Elective fields of Microbial Technology *viz-* Microbial Technology-I (Immuno-diagnostics); Microbial Technology-II (Products and Process Development); Microbial Technology-III (Environmental Conservation and Management) and Microbial Technology IV (Agricultural Management). The Department will also organize two optional Electives *viz* Food Safety and Quality Control; Public Health and Hygiene which will be optional and shall be open even to the students of other Departments.

ORDINANCES

All rules and regulations for conduct of examination pattern, pass percentage and admissions shall be the same as for other post-graduate courses in the Faculty of Science on the University campus. Credit points for the courses shall be the same as decided for other courses of Faculty of Science. 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. The Department shall be free to alter the sequence of courses in any semester depending upon the resources available.

*open elective to be selected from courses offered by other CBCS departments.

Each open elective carries 4 credits.

Ist Semester open elective are self-study courses and the limit of credits earned can be upto 8 credits.

In IInd and IIIrd semester open elective courses offered by other departments one in each semester (IInd and IIIrd) can be qualified to the extent of total 4+4=8 credits.

In IVth semester, courses offered by other CBCS departments in IInd Semester may be additionally qualified. Total minimum 12 open elective credits to maximum 20

credits can be earned by any candidate. In each semester SGPA will be granted including credits of open elective.

Finally after IVth Semester CGPA will be granted.

Number of seats and fee structure

Initially there should be only 20 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.

Eligibility for Admission

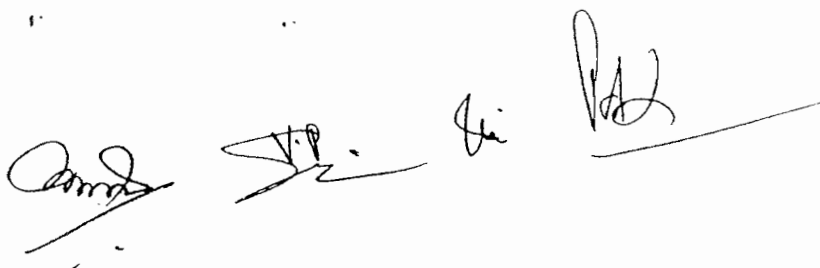
Minimum eligibility for admission in this two year M.Sc. (Microbiology) course shall be undergraduate degree/B.Sc. (Biology group/Medical/Paramedical and Allied subjects)

Appointment of Examiners

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

COURSE STRUCTURE

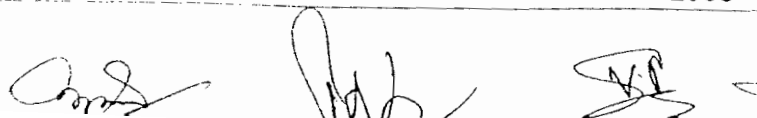
Following course structure is approved:

Four handwritten signatures are present, each with a horizontal line underneath. From left to right, the signatures are: a cursive signature, a signature with 'V.P.' written above it, a signature with 'Hi' written above it, and a signature with 'P.S.' written above it.

M.Sc. (Microbiology) syllabus, C.C.S. University, Meerut
Effective from the session 2017-18 (CBCS based)

| S.N. | Code no. | Name of the course | Credits | | Internal (M.M.) | External (M.M.) |
|------|----------|--|---------|----|-----------------|-----------------|
| | | FIRST SEMESTER | Th | P | | |
| 1 | GM 101 | Microbial Techniques | 4 | 2 | 40 | 40 |
| 2 | GM 102 | Prokaryotes and Acellular Microbes | 4 | 2 | 40 | 40 |
| 3 | GM 103 | Microbial Diversity- Eukaryotes | 4 | 2 | 40 | 40 |
| 4 | GM 104 | Biostatistics, Computer Applications and Bioinformatics | 4 | 2 | 40 | 40 |
| | | *Open Elective | 4 | -- | -- | 100 |
| | | Total Credits of Theory | 20 | -- | -- | -- |
| 5 | GM 105 | Total Practical | -- | 8 | -- | 80 |
| | | SECOND SEMESTER | Th | P | | |
| 6 | GM 201 | Microbial Growth and Physiological Diversity | 4 | 2 | 40 | 40 |
| 7 | GM 202 | Microbial Genetics, Molecular Biology and RDT | 4 | 2 | 40 | 40 |
| 8 | GM 203 | Microbes and Agriculture | 4 | 2 | 40 | 40 |
| 9 | GM 204 | Environmental Microbiology | 4 | 2 | 40 | 40 |
| | | *Open Elective | 4 | -- | -- | 100 |
| | | Total Credits of Theory | 20 | -- | -- | -- |
| 10 | GM 205 | Total Practical | -- | 8 | -- | 80 |
| | | THIRD SEMESTER | Th | P | | |
| 11 | GM 301 | Medical Microbiology | 4 | 2 | 40 | 40 |
| 12 | GM 302 | Molecular Immunology | 4 | 2 | 40 | 40 |
| 13 | GM 303 | Food and Dairy Microbiology | 4 | 2 | 40 | 40 |
| 14 | GM 304 | Industrial Microbiology | 4 | 2 | 40 | 40 |
| | | *Open Elective | 4 | -- | -- | 100 |
| | | Total Credits of Theory | 20 | -- | -- | -- |
| 15 | GM 305 | Total Practical | -- | 8 | -- | 80 |
| | | FOURTH SEMESTER | Th | P | | |
| 16 | GM 401 | Microbial Technology-I (Immuno-diagnostics) | 4 | 2 | 40 | 40 |
| 17 | GM 402 | Microbial Technology-II (Products & Process Development) | 4 | 2 | 40 | 40 |
| 18 | GM 403 | Microbial Technology-III (Environmental Conservation & Management) | 4 | 2 | 40 | 40 |
| 19 | GM 404 | Microbial Technology-IV (Agricultural Management) | 4 | 2 | 40 | 40 |
| | | *Open Elective | 4 | -- | -- | 100 |
| | | Total Credits of Theory | 20 | -- | -- | -- |
| 20 | GM 405 | Total Practical | -- | 8 | -- | 80 |
| | | Marks | | | 640 | 1360 |
| | | TOTAL MARK | | | | 2000 |

2000



Code- GM 101: Microbial Techniques

Unit I: Microscopy & Staining techniques: Basic principles for the examination of microbes by light, dark field, phase contrast, confocal, fluorescent and electron (transmission and scanning) microscopy; Micrometry; Specimen preparation and basic principles of Simple, Gram's stain, Capsule, Endospore, Flagella, Acid fast and Nuclear/Geimsa's staining.

Unit II: Basic principles and methods of sterilization: control of microorganisms by physical methods: heat, filtration and radiation; chemical methods: phenolics, alcohols, halogens, heavy metals, quaternary ammonium compounds, aldehydes and sterilizing gases; evaluation of antimicrobial agent effectiveness. Principle and functioning of LAF.

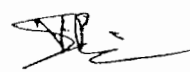
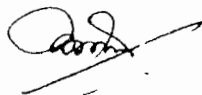
Unit III: Basic principles and methods of media preparation: types of culture media: simple media, complex media, synthetic media, enriched media, selective media, indicator media, differential media, anaerobic media; pH and buffers; Pure culture techniques: streak plate, dilution plate and spread plate method; maintenance of pure cultures; methods of preservation of various microbes.

Unit IV: Basic principles and applications of spectrophotometry & Chromatography : Beer-Lambert law; interaction of radiation with matter, absorption of radiation, emission of radiation; UV-Vis spectrophotometry, Fluorimetry, Flame photometry and atomic absorption spectrophotometry; Chromatography (paper, thin layer, column, gel filtration, ion-exchange and affinity chromatography); GLC, HPLC and FPLC.

Unit V: Miscellaneous techniques: Principles and applications of Electrophoresis for protein and DNA; Iso-electric focusing and 2-D gel electrophoresis; Autoradiography, X-Ray diffraction; Centrifugation; Ultracentrifugation; Dialysis, Ultrafiltration; Lyophilization.

Suggested Readings (Latest Editions):

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.
2. Wilson K. and Walker J. (2013). Principles and Techniques of Biochemistry and Molecular Biology. Cambridge University Press.
3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
4. Upadhyaya and Nath (2015) Biophysical chemistry, Himalaya pub. House.
5. T.A.Brown (2016). Gene cloning and DNA analysis, an introduction, Wiley Blackwell pub.
6. B.D.Singh (2015). Biotechnology. Kalyani publication.



Code- GM 102: Prokaryotes and Acellular Microbes

Unit I: Discovery of microbial world; 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 archaea.

Unit II: Current status of microbes in the living world, Brief developmental History of the evolution of three domain of life. Modern trends in microbial taxonomy including RNA world. Salient features of Bergey's Manual of Determinative bacteriology.

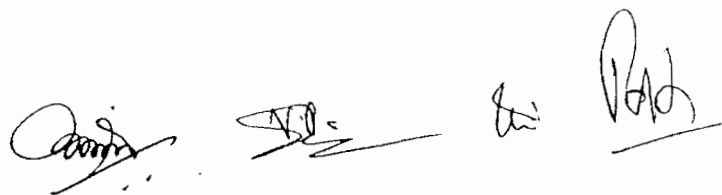
Unit III: General characteristics including cell structure of bacteria and Archaea; Extreme environments and extremophiles; General characteristics of thermophiles, psychrophiles, osmophiles, acidophiles, alkaliphiles and halophiles including ecology, adaptation and biotechnological applications. General characteristics of Cyanobacteria- ultrastructure and economic importance.

Unit IV: General characters, nomenclature, classification, morphology and ultra-structure of viruses; Capsid and their arrangement; Cultivation of viruses using embryonated eggs, experimental animals and cell cultures (Cell-lines, cell strains and transgenic systems). 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 and major diseases caused by them.

Suggested Readings (Latest Editions):

1. Bergey's manual systematic Bacteriology(2011) 2nd edition
2. Prakash S. Bisen (2012). Microbes-concepts and applications, Wiley-Blackwell.
3. J.D.S.Panwar (2012)-Fundamentals of Microbiology-S.R.S Pub
4. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hil
5. Bisen, P.S. (2014). Microbes in Practices, I K international publication house pvt Ltd.
6. Sharma P.D. (2015-16). Microbiology, 3rd edn. Rastogi publications
7. J.G.Black(2015) –Microbiology. 9th edition, Wiley publication



Code- GM 103: 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 cycle; Classification of eukaryotic microbes; Evolutionary relationship of each group based on modern systems of classification.

Unit II: Current status of fungi and their classification including organisms belonging to Protozoa, Stramimipila (=Chromista) and Eumycota (true fungi), Thallus organization, asexual and sexual reproduction in Myxomycota, Oomycota, Zygomycota, Ascomycota and Basidiomycota.

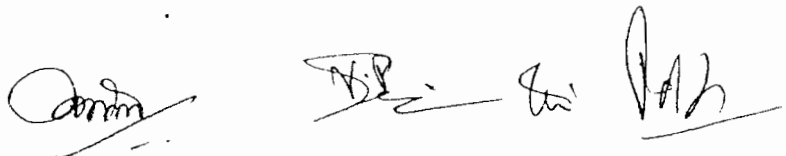
Unit III: Heterothallism; sex hormones in fungi; physiological specialization and phylogeny of fungi. Parasexual life cycle; Economic importance of fungi. Lichen and their symbiotic relationship. Economic importance of lichens.

Unit IV: General characteristics of algae; Classification of algae; Somatic structure, asexual and sexual reproduction of microbiologically important genera of Chlorophyceae, Phaeophyceae, Bacillariophyceae, Rhodophyceae and Dinophyceae. Algal nutrition, ecology and biotechnology; Economic importance of algae.

Unit V: General characteristics of Protozoans; and Nematodes; Difference between protozoans and nematodes; Structure and reproduction of microbiologically important genera of protozoans (*Entamoeba*, *Giardia*, *Trichomonas*, *Leishmania*, *Trypanosoma*, *Plasmodium*) and Nematodes: *Ancylostoma*, *Ascaris lumbricoides*, *Necator*; Cestodes: *Taenia solium*, *Taenia saginata*, *Diphyllobothrium*, *Echinococcus granulosus* and Trematodes: *Paragonimus*, *Fasciola hepatica*, *Schistosoma*; Difference between Protozoans and Nematodes.

Suggested Readings (Latest Editions):

1. Chatterjee K.D. (2015). Parasitology, Calcutta publication.
2. David Greenwood (2015). Medical Microbiology, 18th edition.
3. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
4. J.G. Black (2015) –Microbiology, 9th edition, Wiley publication
5. Lee. R. E. (Latest Edition). Phycology, Cambridge University Press, Cambridge.
6. Talaro K.P. & Talaro A. (Latest Edition). Foundations in Microbiology (6th Ed.), McGraw-Hill College Dimensi.
7. Sharma, P.D. (2016). Mycology and Phytopathology, Rastogi Publications, Meerut



Code- GM 104: Biostatistics, Computer Applications and Bioinformatics

Unit I: Presentation of data; Frequency distributions; Graphical representation of data by histogram, polygon, frequency curves and pie diagram. Measures of central tendency: Mean, median and mode; Measures of dispersion: Mean deviation, standard deviation, variance, Standard error, coefficient of variation; Correlation and regression : properties, nature, coefficient of correlation, rank correlation, linear regression and regression equations and multiple linear regression, significance of correlation and regression.

Unit II: Probability: Basic concepts related to probability theory, classical probability. Probability Distributions: Introduction and simple properties of Binomial, Poisson and Normal Distributions and their applications in biology. Sampling: Concept of sampling and sampling techniques.

Unit III: Testing of hypotheses: Some basic concepts. Errors in hypothesis testing; critical region; Students t-test for the significance of population mean and the difference between two population means; Paired t-test; Chi square test for population variance, goodness of fit and for the independence of two attributes in a contingency table; F-test for the equality of two population variance; Analysis of variance- One-way and two-way analysis of variance.

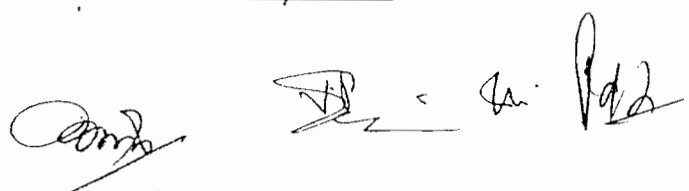
Unit IV: Introduction to Computers : Definition, Components of computer, Classification of Computers, Generation of Computers; Number system; Introduction to Software; Translators (Compiler & Interpreter); Basics for operating systems (MS-DOS, Windows, Unix and Linux); Introduction to MS Office (MS-Word, MS-Excel, MS-Power Point); Introduction to Networking, Internet (E-Mail, File Transfer Protocol, Usenet, Telnet).

Unit V: Introduction to Bioinformatics: Definition and scope; Search engines: tools for web search; Introduction to biological databases (NCBI, EBI, DDBJ, GenBank, PDB, NDB and MMDB), Introduction to BLAST and FASTA; Brief idea about important softwares for microbiological studies.

Suggested Readings (Latest Editions):

1. Bailey, NT J (2000). Statistical Methods in Biology. English Univ. Press.
2. Campbell R.C (Latest Edition). Statistics for Biologist. Cambridge University Press, UK.
3. Sinha PK (Latest Edition). Fundamentals of computers. BPB Publication, New Delhi
4. Jonathan, P. 2008. Bioinformatics & Functional Genomics.
5. B.D. Singh (2015). Biotechnology, Kalyani Publication.
6. Sharma and Munjal (2015). A test book of Bioinformatics, Rastogi publication.

Code- GM 105: Practical (based on courses 1 to 4)

101 104


Code- GM 201: Microbial Growth and Physiological Diversity

Unit I: Nutritional groups of microbes, nutritional uptake; transport across the membranes and cell wall (diffusion, passive diffusion, active transport, group translocation and iron uptake); Physiology of growth and kinetics, Growth curve, measurement of growth (biomass, turbidity, dry weight, protein content); environmental factors affecting microbial growth.

Unit II: Photosynthesis: Adsorption light, photosynthetic and accessory pigments, (chlorophyll, bacteriochlorophyll, carotenoides, phycobilliproteins); Oxygenic and non-oxygenic photosynthesis in prokaryotes, electron transport chain and phosphorylation; Calvin cycle; effect of light, temperature, pH, and CO₂ on the rate of photosynthesis; Photosynthetic yield and Photorespiration.

Unit III: Respiratory metabolism: Glycolytic pathway of carbohydrates breakdown, Embden Meyer Hoff pathway, Kreb's cycle, and Entner-Duodoroff pathway, Phospho-ketolase pathway; Pentose phosphate pathway; oxidative and substrate level phosphorylation; Gluconeogenesis, glyoxylate cycle, reverse TCA cycle; Fermentation of carbohydrates, homo and heterolactic fermentation.

Unit IV: Carbohydrates: Structure and properties of starch, cellulose, hemicellulose, glycogen and their derivatives; structure of lignin; General characters of fats, saturated and unsaturated fatty acids, biosynthesis of fatty acids, oxidation of fatty acids; distribution and functions of lipids in microbes.

Unit V: Classification, structure and properties of proteins, Structure of amino acids, Classification of essential amino acids based on polarity, protein sequencing, peptide synthesis; methods of protein purification. Classification and nomenclature of enzymes; mechanism of enzyme action, enzyme inhibition, allosteric enzymes, enzyme kinetics. Principles of Physical chemistry; Thermodynamic principles in biology; Energy rich bonds; Weak interactions; Bioenergetics.

Suggested Readings (Latest Editions):

1. Nelson D and Cox MM. (2010). Lehninger's Principles of Biochemistry. W.H. Freeman and Company, New York.
2. Voet D and Voet JG. (2013). Principle's of Biochemistry. John Wiley and sons New York.
3. Moat AG and Foster J W (Latest Edition). Microbial Physiology. John Wiley and Sons, New York.
4. Stryer. L (2003). Biochemistry. W. H. Freeman and Co.
5. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology. 9th edi McGraw Hil
6. J.L. Jain(2015).Fundamentals of Biochemistry, S. Chand and Co.
7. U. Satyanarayan(2015). Biochemistry, Elsevier



Code- GM 202: Microbial Genetics, Molecular Biology and RDT

Unit I- Nucleic acids as genetic information carriers, DNA structure, types of DNA. DNA replication in prokaryotes & eukaryotes. Structural features of RNA (mRNA, tRNA, rRNA). Transcription in prokaryotes & eukaryotes.

Unit II- Regulation of gene expression. Basic features of the genetic code. Protein synthesis in prokaryotes and eukaryotes. Recombination: general principles. Plasmids (types of plasmids- F plasmids, R plasmids, Col plasmids & Ti plasmid). Gene transfer mechanisms: transformation, transduction, and conjugation.

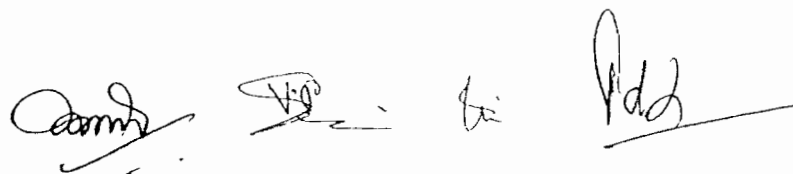
Unit III- Mutations: spontaneous mutation, Induced mutagenesis- mutagens (physical mutagens: non ionizing & ionizing radiations; chemical mutagens: Base analogues, alkylating agents, deaminating agents, intercalating agents & others), molecular mechanism of mutagenesis. DNA repair mechanism: repair by direct reversal, excision repair, recombinational repair & SOS repair.

Unit IV- Basic steps of r-DNA technology. Restriction endonucleases. Cloning vectors: general properties, plasmids, bacteriophages, cosmids, shuttle vectors, bacterial artificial chromosomes. Eukaryotic cloning vectors for yeast, & animal cells. Gene libraries: genomic library (Shot gun approach), c DNA library (Different methods for synthesizing c DNA molecules).

Unit V- Molecular Techniques; Principles, methods & their applications in medical diagnosis - such as PCR, Southern Blotting, Northern Blotting, RFLP, RAPD, Western Blotting, DNA finger printing and DNA sequencing. Microbial genetic & design of vaccines; for TB & leprosy. DNA vaccines design & advantages. Recombinant vaccines.

Suggested Readings (Latest Editions):

1. David P Clark (2010). Cell and Molecular Biology
2. Robert J. Brooker (2011). Genetics, Analysis and principles, Mc Graw Hill.
3. J.E. Krebs (2011). Lewin's Genes X, Jones Pub.
4. T.A. Brown (2010). Gene cloning of DNA Analysis. Wiley Blackwell.
5. J D Watson (2008), Molecular biology
6. Jeff Hardin, Gregory Bertoni, Lewis J. Kleinsmith (2012). Becker's Word of the cell.
7. William. D Stans Field (2012). Molecular and cell Biolgy, Mc Graw Hill pub.
8. Gerald Karp (2014). Cell Biology, Wiley Blackwell, Pub.



Code- GM 203: Microbes and Agriculture

Unit I: Microorganisms as biofertilizers : Biofertilizers and symbiotic associations : *Rhizobium*, *Azospirillum*, *Azotobacter*, Cyanobacteria, Mycorrhiza and actinorrhiza in plant nutrition and stress tolerance; Commercial production of biofertilizers with special reference to Indian market. Biological Nitrogen fixation, oxygen and hydrogen regulation of nitrogen fixation, nitrification, denitrification and ammonifying bacteria, Pathway of nitrate assimilation in photosynthetic and non-photosynthetic systems, transamination and deamination reactions.

Unit II: Disease forecasting and basic principles of plant disease control. Etiology, causal organism, disease cycle and control of economically important crop diseases of wheat (Tundu, Rusts and smuts), rice (BLB, BLS and false smut) barley (stripe, powdery mildew), maize (downy mildew), sugarcane (red stripe, ratoon stunting, grassy shoot), vegetables (downy mildew of crucifers and cucurbits, white rust of crucifers) and pulses (wilt of pigeon pea, Phytophthora blight of pigeon pea).

Unit III: Microorganisms as biopesticides: Microbiology of plant surfaces; Principles and mechanism of biological control; Biocontrol agents of pathogen insect pests and weeds. Commercial reality of biopesticides limitations for Indian agriculture: Integrated pest management.

Unit IV: Soil microbiology: Soil as a habitat for microorganisms; Soil enzymes, Soil water and microbial activity, Soil microorganisms and nutrient cycle. Soil fertility and management of agricultural soils; Microbiology of composting; Reclamation of barren lands using microbial technology; Microbiology of plant surfaces. Rhizoplane, phylloplane and rhizosphere microbes, their interaction with plants.

Unit V: Biodeterioration of agricultural produce; Mycotoxins; Diseases of food products during transmit and storage and their management.

Suggested readings (Latest edition)

1. Sharma, P.D. (2016). Plant Pathology, Rastogi publications
2. Rao, N.S.S. (2015). Soil Microbiology. Oxford & IBH Publishing Co., New Delhi.
3. Jeffery C. Pommerville (2014). Alcamo's Fundamental Microbiology, Jones pub.
4. Ghulam Hassan Dar (2010). Soil Microbiology and Biochemistry
5. Agrios G. N. 2005. Plant Pathology. 5th Edition, Academic Press. San Diego.
6. Christon J. H. 2001. A Manual of Environmental Microbiology. ASM Publications.
7. Forster C. F. & John DA 2000. Environmental Biotechnology. Ellis Horwood Ltd. Publication.



Code- GM 204: Environmental Microbiology

Unit I: Microbial Ecology versus Environmental Microbiology; Historical perspectives; Major fields and modern Environmental Microbiology; Overall role of microbes in ecosystem. Aeromicrobiology and aquatic microbiology-Allergic disorders; Bioaerosols; Biowarfare agents; Air sampling of bioaerosols; Microbial growth patterns in aquatic environments.

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, Fe, Mn, Hg,.

Unit III: Microbiomics and microbial interactions: Normal microbiota of human body and microflora of ruminants body; Microbes-Animals, Microbes-plant interactions: Phyllosphere, Rhizosphere, Endophytes, PGPM, Mycorrhiza.

Unit IV: Microbial degradation, deterioration and bioremediation; Biodegradation of xenobiotics including pesticides and military chemicals (explosives and gases); Biocorrosion of metals; Microbe –metal interactions (bioleaching, biomining, biohydrometallurgy); Enhanced petroleum recovery; Integrated microbial bioremediation including oil spills; Role of biosurfactants.

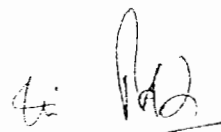
Unit V: Microbes and water potability- Purification of potable water; Sanitary analysis of water (indicator microbes and methods of their detection); Standards(tolerable levels) of water quality of faecal contamination. Microbes in solid waste and sewage management- Sanitary land fills and composting; Solid waste management in India; Methods of sewage management (composition of sewage, small scale and modern sewage treatment methods – oxidation ponds, trickling filters, biodisc system); Measurement of water quality after sewage removal.

Suggested Readings (Latest Editions):

- 1.Sharma, P.D. (2016). Environmental Microbiology, Rastogi Publications.
- 2.Prakash S. Bisen (2014). Microbes in practice-I K international publication house pvt ltd.
- 3.Prakash S. Bisen (2012). Microbes-concepts and applications Willey BlackWell Pub.
- 4.Pepper IL, Gerba CP and Brusseau ML (2006). Environmental and Pollution Science. Academic Press. USA
- 5.Forster CF and John DA (2000). Environmental Biotechnology. Ellis Horwood Ltd. Publication.
- 6.Christon JH (Latest Edition). A Manual of Environmental Microbiology. ASM Publications.
- 7.Maier RM, Pepper IL and Gerba CP (2000). Environmental Microbiology. Academic Press. USA
- 8.Michel R (Latest Edition). Introduction of Environmental Microbiology.

Code- GM 205: Practical (based on courses 6 to 9)

201 204

Code- GM 301: Medical Microbiology

Unit I: Classification of medically important bacteria; Normal flora of human body, role of the resident flora; collection of clinical samples and laboratory diagnosis of important bacterial infections, pathogenic microorganisms. Brief account of major air, water and soil borne diseases of microbial origin and their prevention and control measures.

Unit II: Bacteriology: Important human diseases caused by *Staphylococcus*, *Streptococcus*; *Neisseria*; *Bacillus*; *Corynebacterium*; *Clostridium*; Organisms belonging to Enterobacteriaceae (*Escherichia coli*, *Klebsiella*, *Salmonella*, *Shigella* and *Proteus*); *Pseudomonas*; *Haemophilus*; *Mycobacterium*; Antibacterial drugs and susceptibility test; Bacterial vaccines. Mechanism of drug resistance in pathogenic bacteria and fungi.

Unit III: Virology: Collection of clinical samples and laboratory diagnosis of important viral diseases; Mumps; Measles; Influenza; Adenovirus; Enterovirus; Rhinovirus; Poxvirus; Hepatitis; Herpesvirus; AIDS; Antiviral drugs; Viral vaccines; Interferons; Tumor viruses; antiviral agents and susceptibility test.

Unit IV: Mycology: Classification of medically relevant fungi: Collection of clinical sample and laboratory diagnosis of important human fungal diseases: Phycomycosis; Candidiasis; Dermatophytosis; Aspergillosis; Otomycosis; Cutaneous and subcutaneous mycoses; Systemic mycoses; Opportunistic mycoses; Antifungal agents and susceptibility test.

Unit V: Parasitology: Important diseases caused by intestinal and urogenital protozoa: *Entamoeba*; *Giardia*; *Trichomonas*; Blood and tissue protozoa; *Plasmodium*; *Trypanosoma*; *Leishmania*; Cestodes: *Taenia*; Trematodes: *Schistosoma*; *Paragonimus*; Nematodes: *Ascaris*; *Ancylostoma*; *Necator*; their laboratory diagnosis, treatment and prevention; antiparasitic agents and susceptibility test.

Suggested Readings (Latest Editions):

1. Kenneth. J. Ryan (2010) Sheris's Medical Microbiology, Mc Graw Hill.
2. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
3. Greenwood D (2015). Medical Microbiology, 18th Edition, Elsevier.
4. Murray PR, Pfaller MA, Tenover FC and Tenover FC (2007). Clinical Microbiology. ASM Press.
5. K.D Chattergy (2015). Parasitology, CBS Pub.
6. Harvey, R.A., Champe, P.C. and Fisher, B.D. (Latest Edition). Lippincott's Illustrated Reviews: Microbiology. Lippincott Williams and Wilkins, New Delhi/New York.



Code Course GM 302: Molecular Immunology

Unit I: Introduction to the immune system: Innate immunity; anatomic, physiological, phagocytic & inflammatory barriers. Adaptive immunity; natural & artificial immunity. Cells involved in immune response: lymphoid lineage (producing B & T lymphocytes) & Myeloid lineage (phagocytes: macrophages, neutrophils & eosinophils and auxillary cells; basophils, mast cells & platelets). Organs involved in immune system: primary & secondary lymphoid organs.

Unit II: Antigens: preparation of antigens, types of antigens- haptens, superantigens & cluster of differentiation molecules (CDs), Processing and presentation of antigens.. Immunoglobulins: structure & types of immunoglobulins, genetic diversity of immunoglobulins, catalytic antibodies. B-cell biology & T-cell biology (major histocompatibility complex (MHC) molecules). HLA and H-2 systems.

Unit III: Vaccines immunizations: types of vaccines (DNA vaccines, recombinant DNA vaccines, synthetic peptide vaccines, multivalent subunit vaccines) & their characteristics. Immunization of test animals, hyperimmune antisera; Prophylactic immunization; Immune Disorders: hypersensitivities, autoimmune diseases, transplantation (tissue) rejection, immunodeficiency's.

Unit IV: Complement: Classical alternative and lectin pathway of complement activation, regulation of complement system, biological consequence of complement activation. Cytokines: interferons (α , β & γ), TNF, interleukins (1-16), hematopoietins & chemokines, Regulation of immune response.

Unit V: Monoclonal antibodies: hybridoma technology, applications of monoclonal antibodies. Antigen-Antibody reactions in vitro: agglutination reactions (Widal, Haemagglutination), precipitation reactions (Immunodiffusion, Immuno electrophoretic method), Immunoblotting, ELISA, RIA, fluorescence immunosorbent assay, immuno-electronmicroscopy.

Suggested Readings (Latest Editions):

1. Riott I M (2003). Essentials of Immunology. Blackwell Scientific Publishers. London.
2. Claus D (2005). Immunology- Understanding of Immune System. Wiley - Liss, New York.
3. William P (Latest Edition). Fundamentals of Immunology.
4. Abbas (2004). Cellular and Molecular Immunology.
5. Benjamin (2004). Immunology- A short Course.
6. Tizard Ian R (2009). Immunology. An introduction, 4th Edition.
7. Kindt, Goldsby and d Osborne (2013). Kuby Immunology. MacMillan Higher Education.



Code - GM 303: Food and Dairy Microbiology

Unit I: Important microbes involved in spoilage of food, meat, poultry, vegetables and dairy products; food preservation. Microbial deterioration of cereals, pulses, fish and sea-foods during storage; Common food borne pathogens, diseases caused by them and their symptoms, food borne illness, prevention and complication of food borne diseases outbreaks, epidemiology

Unit II: Bacterial and mycotoxins, Important microbes secreting toxins, chemical nature of important toxins: their role in food poisoning; physiology and mechanism of action, modification and detoxification; prevention and control of toxin contamination.



Unit III- Microbial biomass: Single cell proteins and myco-protein; Use of microbial enzymes in food; Food quality monitoring, Fermented foods and traditional fungal foods (shoya, miso, tempe etc.). Fermented vegetable, meat and milk products (cheeses, butter and yoghurt).

Unit IV- Use of microbial enzymes in food; low calorie sweeteners, Flavour modifiers; Food additives; Food quality monitoring, biosensors and immune-assays, Indian fermented foods.

Unit V- Role of microbes in milk and dairy products, 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; Manufacture of cheeses, butter, yoghurt and fermented milk.

Suggested Readings (Latest Editions):

1. Butt, TM, Jackson CW and Magan N (2004). Fungi as Biocontrol agent. CABI Publishing, UK.
2. Adams (2004). Food Microbiology.
3. Prajapati (2007). Fundamentals of Dairy Microbiology.
4. John C. Ayres OM, William ES (2004). Microbiology of Foods. W. H. Freeman and Co.
5. Robinson (Latest Edition). Dairy Microbiology.
6. Jay JM (2000). Modern Food Microbiology. Van Nostraaand Reinhold Co., New York.
7. Andrew Proctor (2011). Alternatives to conventional food processing, RSC pub.
8. Frazer WC and Westhoff DC (2014). Food Microbiology. Mcgraw Hill, New York.
9. B.D. Singh(2015). Biotechnology, Kalyani Publication



Code GM 304: Industrial Microbiology

Unit I (a) : Sources and characters of industrial microbes, their isolation, purification & maintenance. Screening of useful strains: primary screening & secondary screening. Strain improvement through random mutation (random & rational selection), genetic recombination & genetic engineering.

Unit I (b) : Fermentation technology: microbial growth kinetics in batch, continuous & fed-batch fermentation process. Stirred aerobic bioreactor: principles & designing. Other types of bioreactors. Raw materials used in fermentation media. Solid state fermentation & submerged fermentation: their advantages & disadvantages.

Unit II: Microbial transformations with special reference to steroids & alkaloids. Primary & secondary metabolites. Commercial production of antibiotics with special reference to penicillin, streptomycin and their derivatives.

Unit III : Microbiology & production of alcoholic beverages: malt beverages, distilled beverages, wine & champagne. Commercial production of organic acids like acetic, lactic, citric, & gluconic acids. Commercial production of important amino acids (glutamic acid, lysine & tryptophan), insulin & vitamins (vitamin B₁₂, riboflavin & vitamin A).

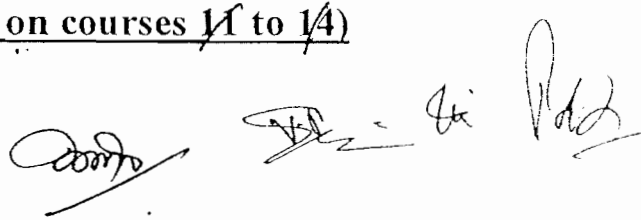
Unit IV: Immobilization of microbial enzymes and whole cells and their applications in industries. Food fermentations: bread, vinegar, fermented vegetables, fermented dairy products & their spoilage. Bioprocess Engineering: Downstream processing, various steps for large scale protein purification. Single cell proteins, Physiological aspects, SCP from waste materials and renewable resources.

Unit V : Industrial enzymes production : Cellulases, Xylanases, Proteases, Amylases, Lipases & Pectinases and their applications. Bioconversion of waste for fuels (ethanol and methane). Mushroom cultivation. Petroleum microbiology. Patent protection for biological inventions.

Suggested Readings (Latest Editions):

1. Reed G (2004). Industrial Microbiology. CBS Publishers (AVI Publishing Co.)
2. Stanbury PF, Whitekar A. and Hall (2006). Principles of Fermentation Technology. Pergaman, McNeul and Harvey.
3. Creuger and Creuger (2005). Biotechnology- A textbook of Industrial Microbiology. Panima pub.
4. Casida LE (2010). Industrial Microbiology, Wiley Eastern.
5. Atlas RM (Latest Edition). Petroleum Microbiology. Macmillan Publishing Co.
6. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill
7. B.D. Singh (2015). Biotechnology, Kalyani Publication

Code- GM 305: Practical (based on courses 11 to 14)

301 304


Code GM 401: MICROBIAL TECHNOLOGY-I
(IMMUNO-DIAGNOSTICS)

UNIT-I: Modern Immunological Therapy: Kinetics of immune response and memory; Hybridoma technology; production and purification of monoclonal antibodies; Antibody engineering, Antibody as in vitro and in vivo probes; Immunotoxins, Immunodiagnosics and Immunotherapeutics. Immunoassay: solid immunoassay & their chemistry, Immunocytochemistry, Immunohistochemistry, Immunoediting, Immune surveillance theory.

UNIT-II: Molecular Oncology: Detection of recognized genetic aberrations in clinical samples; types of cancer causing alterations revealed by next generation sequencing of clinical isolates; predictive biomarkers for personalized oncotherapy of human disease such as chronic myeloid leukemia, colon, breast, lung cancer and melanoma as well as matching targeted therapies with patients and preventing toxicity of standard systemic therapies; Tumor evasion of the immune system. Cancer immunotherapy.

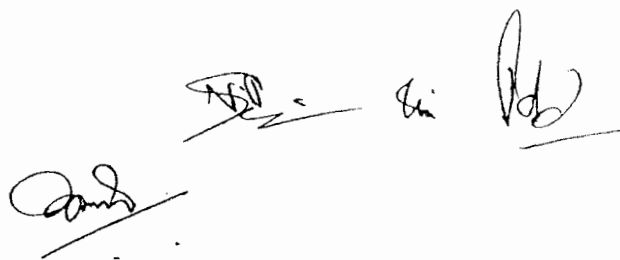
UNIT-III: Commercial Immunodiagnostic kits for common diseases: Dengu, HIV/AIDS, Chikun gunya, ELISA kit, Rapid diagnostic test kit, BCG, Typhoid.

UNIT-IV: Common Vaccine development: Licensed vaccines, Viral Vaccines (Poliovirus vaccine-inactivated and Live, rabies vaccines, Hepatitis A& B vaccines), Bacterial Vaccine (Anthrax vaccines, Cholera vaccines, Diphtheria toxoid), Parasitic vaccine (Malaria Vaccine).

UNIT-V: Vaccine Production: The vaccine industry, vaccine manufacturing, Evolution of adjuvants across the centuries, New generation vaccines (bacterial, viral), Edible vaccines, Vaccine additives and manufacturing residuals, Regulation and testing of vaccines.

Suggested Readings (Latest Editions):

1. Riott I M (2003). Essentials of Immunology. Blackwell Scientific Publishers. London.
2. Murray PR, Pfaller MA, Tenover FC and Tenover RH (2007). Clinical Microbiology. ASM Press.
3. Tizard Ian R (2009). Immunology. An introduction, 4th Edition.
4. Kenneth. J. Ryan (2010) Sheris's Medical Microbiology, Mc Graw Hill.
5. Kindt, Goldsby and d Osborne (2013). Kuby Immunology. MacMillan Higher Education.
6. Willey J, Sherwood L. and Woolverton C (2014). Prescott's Microbiology, 9th edi McGraw Hill.
7. Greenwood D (2015). Medical Microbiology, 18th Edition, Elsevier.



Code- GM 402: MICROBIAL TECHNOLOGY - II (PRODUCTS AND PROCESS DEVELOPMENT)

UNIT-I Bioprocess technology: Microbial growth patterns and kinetics in batch culture, Microbial growth parameters. Quantitative analysis of microbial growth by direct & indirect methods, Role of diffusion in Bioprocessing, Different regulatory mechanisms involved in controlling the catabolic and anabolic processes of microbes. Basic concepts of computer modelling and optimization in bioprocess applications.

UNIT-II Bioreactor design: General requirements of fermentation process, types of fermentation and fermenters; batch, fed batch and continuous. Solid state and submerged fermentation. Microbial growth kinetics-Monod equation, Stoichiometry of cell growth-mass and energy balances, yield coefficients, growth limiting substrate and yield factors, factors of optimization, rheology of fermentation fluids, Oxygen transfer kinetics.

UNIT-III Details of the process, parameters and materials - for industrial production of Antibiotics (penicillin, streptomycin and their derivatives), Biopharmaceuticals (Insulin/Interferon). Role of microbes in milk and dairy products, Food fermentation- bread, cheese, vinegar, yogurt, sour milk, oriental fermented foods. Production of starter culture (LAB) for dairy industries. Microbial biomass: Single cell proteins and myco-protein.

UNIT-IV Biofertilizers and biopesticides Plant Growth Promoting Rhizobacteria (PGPR) – mycorrhiza, Mass production of biofertilizers and quality control. Biopesticides - microbial pesticides, Bioconversion of waste for fuels: production of CH₄, bioethanol, biogas and other hydrocarbons, biodiesel and H₂ as fuel by microbes; Immobilization of microbial enzymes and whole cells and their applications in industries. Industrial enzymes production: Cellulases, Xylanases, Proteases, & Amylases

UNIT-V Fundamentals of Bioentrepreneurship: decision making for starting a venture, sources of financial assistance, approaching the sources for loan, statutory and legal requirements of starting a company, assessment of market demand for product, developing distribution channels: pricing/policies/ competition/ promotion/ advertising, negotiation strategy with various agencies, Human resource development

Suggested Readings (Latest Editions):

1. Cruger, W. and Anneliese Cruger, A. 2005. Biotechnology, A text book of industrial Microbiology, Panima Publishers, New Delhi, 2nd Edition
2. Casida, L.E. 2010. Industrial Microbiology, Willey Eastern Ltd, New Delhi, 1st Edition
3. Stanbury, P.F. and Whitaker, A. 2005. Principles of Fermentation Technology, Pergamon Press, Oxford, 2nd Edition
4. Okafar, N. 2007. Modern Industrial Microbiology and Biotechnology, 1st Edition



Code- GM 403: Microbial Technology-III
(Environmental Conservation and Management)

Unit I: Environmental Conservation and Energy Management: Principles and Strategies for conservation of environment; Energy management measures in steam systems- losses in boiler, energy conversion in refrigeration and air conditioning system, Energy efficient motors, Electrical energy management.

Unit II: Industrial wastewater treatment- Removal of heavy metals, nitrogen and phosphorus, Membrane filtration, electrolysis and evaporation; Biological treatment processes; Chemical oxidation processes, save Ganga by shifting industries from urban areas.

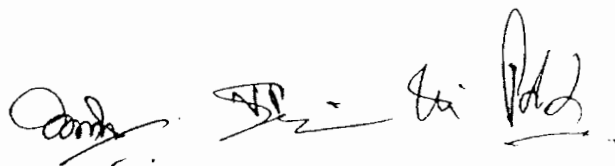
Unit III: Waste water Reuse and Residual Management- Common effluent treatment plants, Zero effluent discharge system, Quality requirements for waste water reuse, industrial reuse, Residuals of industrial waste water treatment.

Unit IV: Sewage treatment and sanitation: Fundamentals of sewage treatment; Septic tank with depression DEWATS, intermittent sand filters. Methods of Sewage disposal, Recycle and reuse of sewage. Solid waste management, Sanitation practices at individual and community level with particular reference to "swachhta mission".

Unit V: Bioresource Management and Landfill: Renewable and Nonrenewable sources of energy and their management, Wild life management and conservation of biosphere. Disposal of electronic waste and landfills.

Suggested readings (Latest Editions):

1. Waste Water Engineering – Treatment, Disposal & Reuse 3rd Ed. Metcalfe & Eddy. Inc. Tata McGraw Hill Pub. Co. 1995.
2. T. H. Tietenberg: Environmental & Natural Resource Economics. 2nd, Ed. Scott. Foreman Pub. Company
3. Rodgers, & Panwar 1988, Planning Protected Area Network in India, Vol. I & II.
4. T. N. Khoshoo (1988) Environment Concerns and Strategies. Ashish Pub. House, Delhi.
5. Pachauri R. K. & Sridharan (1997), Looking back to Think Ahead, The Energy Research Institute, New Delhi
6. R. F. Dasmann (1968) Environment Conservation: John Willey and Sons, New York.
7. Air Pollution by Perkin, H. G. (1974)
8. Fundamentals of Air Pollution by Stern, A. C., Henry Wohlers, G. R. Richard, Boudal, W. and William Lowry, P. (1973).



Code- GM 404: Microbial Technology-IV
(Agricultural Management)

Unit I: Agribusiness environment and Policy: Agribusiness definition and nature, components of agribusiness management, changing dimensions of agribusiness, structure of agriculture, policy control and regulations relating to the industrial sector with specific reference to agro industries, Role of agriculture in Indian economy, problems and policy changes relating to farm supplies, Farm production, agro processing, agricultural marketing, agricultural finance.

Unit II: Agricultural Marketing and Management: Marketing of agriculture in a developing economy, Indian market performance analysis, marketing, price, spread and efficiency, wholesaling and its process, marketing strategy, planning target, retail marketing, international marketing and finance, Agricultural marketing system, government policies, buffer stock preparations, co-operative policies, forward trading, future market strategies.

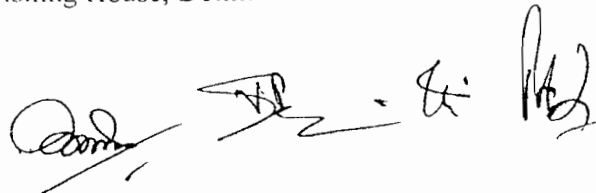
Unit III: Agro based Industries of Western UP: Sugarcane Industry, its management and utilization of its by products, use of agricultural waste in Paper industry – its management, small scale agro based industries like chips, fruit juices, jams, pickles.

Unit IV: Preservation of agro based food products: Management of cold storages, Storage of foods and vegetables in cold stores – their management and quality control.

Unit V: Concept of management: Managing science or art, skills of a manager, significance of goals in organizations, product/market organization problem discovery, Nature of managerial decision making.

Suggested readings (Latest Editions):

1. P. L. Nuthall, Farm business management : the core skills, Wallingford UK ; Cambridge
2. S.C. Panda, Farm Management and Agricultural Marketing, New Delhi.
3. S. Diwase, Indian agriculture and Agribusiness management, Scientific Publisher, Delhi.
4. S. S. Reddy, Agricultural Economics, Oxford Publishing House, Delhi.



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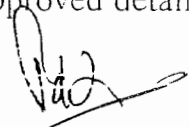

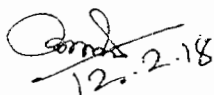
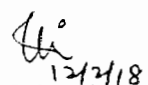
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DEPARTMENT OF MICROBIOLOGY
CH. CHANAN SINGH UNIVERSITY
MEERUT

As per letter no. Committee Cell (BOS-Micro)-3560 dated 05-02-2018, a meeting of the Board of Studies in B.Sc. Food Microbiology, Safety & Quality Control was held at 10:00 a.m. on 12-02-2018 in the Department of Microbiology to finalize the syllabus and ordinances for B.Sc. (Food Microbiology, Safety & Quality Control) under the University Campus w.e.f. the session 2017-2018. Following members were present:

1. Prof. Y. Vimala, Dean & Head, Department of Microbiology, C.C.S. University, Meerut.
2. Professor P.D. Sharma, Ex-Professor of Delhi University, 72 Suncity, Meerut. Subject expert & V.C. nominee
3. Professor V.P. Singh, Ex-Professor of Delhi University, Delhi. Subject expert & V.C. nominee
4. Professor A. P. Garg, Former Coordinator, Currently Pro-V.C. Jaipur National University Jaipur (Special Invitee).

The Committee went through the course contents and the Ordinances of 3 year course of B.Sc. (Food Microbiology, Safety & Quality Control) and approved detailed course contents of the same w.e.f. the session 2017-2018.

| | | | |
|---|---|--|---|
|  |  |  |  |
| (P.D. Sharma) | (V.P. Singh) | (Amar P. Garg) | (Y. Vimala) |
| Subject Expert | Subject Expert | Special Invitee | Dean & Head |

For kind perusal and approval

(Vice-Chancellor)

ORDINANCES FOR

3- year-Degree Course

B.Sc. (Food Microbiology, Safety and Quality Control)

(under Self Finance Scheme)


From the session 2016-17

Department of Microbiology

Ch. Charan Singh University

Meerut


12-2-18


12/02/2018

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, he/she shall be awarded UG Certificate in "Food Microbiology & Food Chemistry". If a candidate drops out after completing two years 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 courses including all practical and compulsory industrial training/project/thesis.

ORDINANCES

All rules for conduct of examination pattern, pass percentage and admissions shall be the same as for other undergraduate three year 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. In first three semesters three internal practicals including a group of three papers (A,B,C) will be carried out followed by single external practical per year. An average of the marks obtained in internal and external will be considered as obtained marks out of 150 in each year. In the third year the practical exam will be based on three courses only carried out as internal and external, the average of which will be finally granted to the student in the first half after session followed by a 4-6 months project work. A candidate will have to complete a project in the third year 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 M.o.U. 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. 50,000/- (Rs. Fifty thousand 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).

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.

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 | Maximum Marks |
|--------------------|----------|---|---------------|
| First Year | | | |
| 1. | FM-101 | Instrumentation (A) | 50 |
| 2. | FM-102 | Microbial Techniques in Food & Water Industry (A) | 50 |
| 3. | FM-103 | Microbial Diversity – Prokaryotes (B) | 50 |
| 4. | FM-104 | Microbial Diversity – Eukaryotes (B) | 50 |
| 5. | FM-105 | Food and Food Sources (C) | 50 |
| 6. | FM-106 | Food Microbiology (B) | 50 |
| 7. | FM-107 | Food Chemistry (C) | 50 |
| 8. | FM-108 | Dairy Technology and Microbiology of Dairy Products (C) | 50 |
| 9. | FM-109 | Biostatistics, Computer Applications & Bioinformatics (A) | 50 |
| 10. | FM-110 | Practical based on A, B, C (Each Practical is of 50 marks) | 150 |
| Second Year | | | |
| 11. | FM-201 | Food Processing & Preservation (B) | 50 |
| 12. | FM-202 | Food Laws & Standards (A) | 50 |
| 13. | FM-203 | Principles of Food Safety (A) | 50 |
| 14. | FM-204 | Principles of Food Quality (A) | 50 |
| 15. | FM-205 | Fermentation Technology (B) | 50 |
| 16. | FM-206 | Water & Food Borne Disease (C) | 50 |
| 17. | FM-207 | Public Health Engineering & Hygiene (C) | 50 |
| 18. | FM-208 | Microbial Genetics, Molecular Biology & Genetic Engineering (C) | 50 |
| 19. | FM-209 | Nutritional Therapy (B) | 50 |
| 20. | FM-210 | Practical based on A, B, C (Each Practical is of 50 marks) | 150 |
| Third Year | | | |
| 21. | FM-301 | Environmental Microbiology | 50 |
| 22. | FM-302 | Food Quality Management Systems | 50 |
| 23. | FM-303 | Food Packaging & Marketing | 50 |
| 24. | FM-304 | Practical | 150 |
| 25. | FM-305 | Project Report | 300 |

NOTE: A Candidate will have to complete a project/training work in the third year.

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.

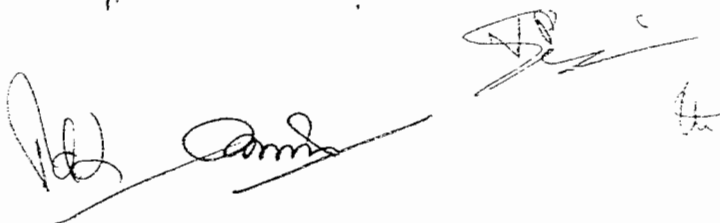
Unit III- Chromatography (paper, thin layer, column, gel filtration, ion exchange, and affinity chromatography), HPLC, FPLC, basic principle and functioning of GC/LC/MS instrument.

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.

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**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 - J 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.

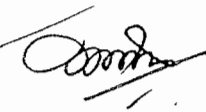
Unit III: Mycotoxins their identification and determination from food samples; Culture of microfungi from different food samples by damp chamber technique and their identification; examination of various solid and soft foods including water samples for fungal contamination by different cultural methods.



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: 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.

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Code FM-106: 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.

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Code FM-107: 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 Hill
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-108: 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

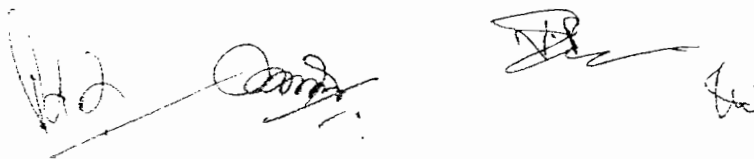
Unit III- Dairy products types (concentrated and dried milk products), health risk of consuming dairy products, back drop of milk preservation methods, refrigeration, milk production level, breeding of milk animals, hormone use, nutrition, pesticide use.

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

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Code FM-109: 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;

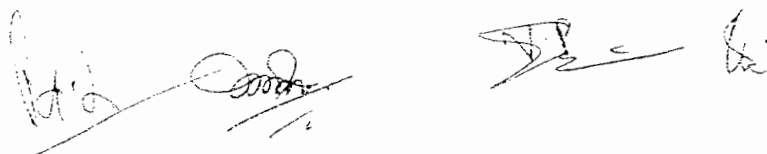
Unit III: Overview of computer systems: Introduction and classification; Components of computer; generation of computers; Number system; Flow chart; Basics for operating system (MS-DOS, WINDOWS, Unix and Linux); Introduction to softwares; MS-Office (MS-WORD, Power Point, MS- Excel).

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-201: 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.

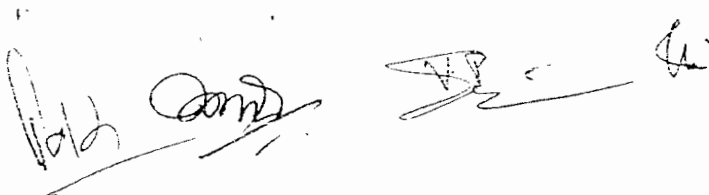
Unit III- Emerging techniques in food processing, modified atmosphere packaging, genetic engineering.

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. Mc Graw Hill Education private Limited New Delhi

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Code-FM 202: 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

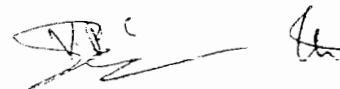
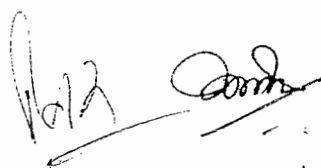
Unit III- Food Safety and Standards Act 2006 (FSSA²⁰⁰⁶)- rules and regulations 2011, existing food laws in India, salient features of Food Safety and Standards Act 2006, Important provision of FSSA, Essential Commodities Act.

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 203: 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,

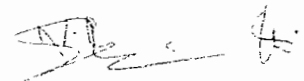
Unit III- Principles and implementation of HACCP- Identification of hazards and control measures, determination of significant hazards, determination of critical control points, establishing the critical limits, Establishment of corrective action, establishment of verification procedure, establish documentation 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 CRC publication. 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 204: 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).

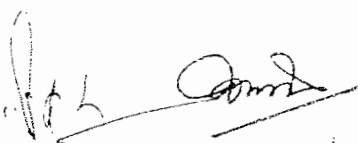
UNIT 3: Quality Control & Selection: Introduction, Legislative requirement, FSA surveillance, Laboratory accreditation and quality control, proficiency testing, Analytical methods: codex Alimentarius commission, European Union, other organizations.

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 CRC publication, 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 205 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.

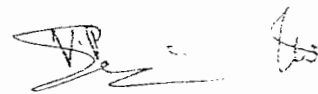
Unit III Food fermentation- bread, malt beverages, wines, distilled liquors, vinegar, fermented vegetables, production of cheeses, butter, yoghurt and fermented milk, oriental fermented foods.

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 Anneliese Cruger, 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- 206: FOOD AND WATER BORNE DISEASE

Unit I Classification of food borne diseases. Food poisoning, infection, and intoxication, non bacterial toxins and mycotoxins Sea food toxicants. Poisoning by chemicals.

Unit II Major food and water borne bacteria *S.aureus*, *Pseudomonas*, *Clostridium*, *Bacillus*, *Vibrio*, *E.coli*, *Salmonella*, *Shigella*, Major food and water borne Viruses- Polio virus, Rotavirus, SARS, Coronavirus, Enterovirus



Unit III Rapid methods for detecting microbial contaminants in foods. Interpretation and application of result and preventive measure

Unit IV Irradiation replaces other food borne disease, microbiological aspect of food, transmission, symptoms, diagnosis, treatment, prevention of disease, Surveillance system for tracking food borne disease.

Unit V Natural waters: Sources of contamination, Microbial indicators of fecal pollution and other pollution, Elevated temperature test, IMViC test Water quality test.

Suggested Readings (Latest Editions):

1. Marth, E.H. and Steele, J.L. Applied Dairy Microbiology, Marcel Dekker, Inc. New York
2. Frazer, W.C. and Westhoff, D.C. Food Microbiology, McGraw Hill, New York.
3. Willey, J., Sherwood, L. and Woolverton, C. Prescott's Microbiology, McGraw Hill, New York.
4. Murray, P.R., Tenover, F.C. and Tenover, F.C. and Tenover, F.C. and Tenover, F.C. Clinical Microbiology. ASM.

Code EN-207: 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. Geofferey Campbell-Platt Food Science and Technology, Willey and Blackwell Publication, UK.
5. Lightfoot NF and Maier EA Microbiological analysis of food and water, Elsevier Publication, Netherland.

The bottom of the page features several handwritten signatures and initials. On the left, there is a large, stylized signature. In the center, there is another signature that appears to be 'Amr'. To the right, there are two smaller signatures, one of which includes the initials 'V.P.' above it.

CELL GENETICS AND MOLECULAR GENETIC ENGINEERING

Unit I: DNA: types as genetic information carriers, general features, DNA structure: historical aspects and current aspects, types: 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 deoxynucleotidyl transferase, 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 Biology.
2. J.E. Krebs, Lewin's Genes X, Jones Pub.
3. F.A. Brown, Gene cloning of DNA Analysis, Wiley Blackwell.
4. H.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.



UNIT I: NUTRITIONAL THERAPY

Unit I: Nutritional therapy. Nutritional requirements of a normal person. Nutritional deficiencies. 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, Peanut allergy, Cow milk allergy, Digestive disorders and diets.

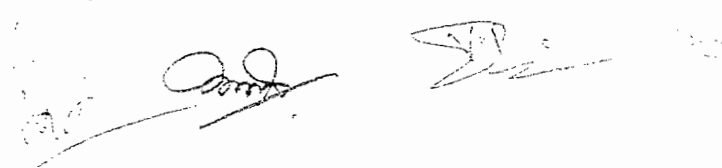
Unit III: Diabetes, types of diabetes, complications associated with diabetes, Therapeutic nutrition and management of diabetes; dietary fat and cholesterol, Renal/kidney conditions, kidney stones, eating the right amount of energy

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, Mc Graw Hill.



ADVANCED ENVIRONMENTAL MICROBIOLOGY

Unit I: Microbial diversity, historical perspectives, modern environmental microbiology, microbial diversity in ecosystem, aeromicrobiology and aquatic microbial ecology, antimicrobials.

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.

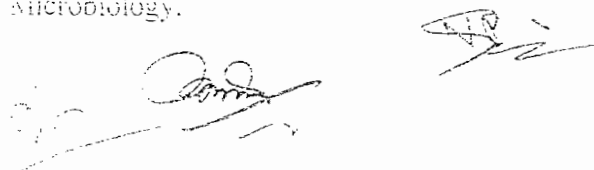
Unit III: Microbiomics and microbial interactions, microflora of ruminants body, microbes-plant interactions, phyllosphere, rhizosphere, endophytes, mycorrhiza, biopesticides.

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 CP and John DA. Environmental Biotechnology. Ellis Horwood Ltd. Publication.
6. Christon JH A Manual of environmental Microbiology. ASM Publications.
7. Maier RM, Pepper IL and Gibb CP. Environmental Microbiology. Academic Press. USA.
8. Michel R. Introduction of Environmental Microbiology.



Unit I: Introduction to management system, ISO 9000: 2000/2008 quality management system - requirement and structure, ISO 14001: 2000 - Environmental management system requirement, OHSAS 18001:2007 Occupational health and safety management system.

Unit II: Laboratory Quality Management System, Overview and Requirements of ISO 17025. Requirements Specific to Food Testing Laboratories - Physical, Chemical and biological parameters. Good laboratory practices (GLP).

Unit III: Standardization and accreditation- international laboratory accreditation cooperation (ILAC). ISO/TS 22003:2007 Food safety management system requirement for bodies providing audit and certification of food safety management system, ISO Guide 65: general requirement for bodies operating product certification system, ISO/IEC 17020: 1998.

Unit IV: Food Quality Management, Characteristics of quality, Quality Control, Quality Assurance, Total Quality Management, Quality Management System, Good Manufacturing Practices, Safety management HACCP - HAXOP.

Unit V: Hygiene and Sanitation in Food Service Institutions: Cleaning and disinfection, Personal hygiene. Pest control, Waste disposal, Evaluation of food quality, sensory tests, Types of tests, sensitivity tests, objective evaluation, Instruments used for texture evaluation. General criteria for the operation of various types of bodies performing inspection, ISO/IEC 17025: 2005 - General requirement for the competence of the testing and calibration laboratories.

Suggested reading (Latest Edition):

1. Goodburn EU food law, Microbiological testing and food safety management. Vol. 7. Blackwell Academic & Professional, London.
2. Microbiological risk assessment in food processing, Edited by Brown, M. and Stringer, M. Woodhead Publishing Limited.
3. Srilakshmi B. Food Science, Delhi: New Age International Private Limited.
4. Suri S and Malhotra S. Food Science, Nutrition and Safety, Pearson India Ltd
5. Marriott NG and Ground RB. Principles of Food Sanitation, New York: Springer.
6. Martin R Adams and M Robert Nout Fermentation and Food Safety, Aspen Publication, Maryland.

Unit 1: Introduction. Role 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. Raija Ahvenainen, 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.

