B.Sc. (Honours) in Microbiology
Under the Framework of Honours School System
PREAMBLE

Microbiology is the study of the vast world of the omnipresent tiny organisms which are too small to be clearly seen with unaided human eye. They are associated with us in various ways and are helping in the sustainability of mankind on this planet. The microorganisms are doing wonders in our daily life ranging from the cleaning of the environment to the production of a wide array of value added products. Although, a few microorganisms are also harming us by acting as the agents of a variety of diseases in humans, plants and animals and also spoiling our foods and other household materials. Knowledge of different aspects of Microbiology has become crucial and indispensable to everyone in the society. Study of microbes has become an integral part of education and human development. Building a foundation and a sound knowledge-base of Microbiological principles among the future citizens of the country will lead to an educated, intellectual and scientifically advanced society. Microbiological tools have been extensively used to study different life processes and are cutting edge technologies. There is a continual demand for microbiologists in the work force – education, industry, environment, hospitals and research.

The Department of Microbiology, Panjab University, Chandigarh is one of the oldest and pioneer Microbiology departments in the country, established in 1964, offering undergraduate and post graduate Honours degrees. The Department, recognized by DBT, DST (FIST & PURSE) and UGC (SAP) under various programmes has well-equipped 3 teaching laboratories, 11 research laboratories, central instrumentation facility, a pilot scale fermentation facility, animal house, computer and networking facility. The Department has experienced faculty with expertise in various disciplines of Microbiology including Medical Microbiology & Immunology, Industrial Microbiology & Fermentation Technology, Molecular Biology, Environmental Microbiology. Besides intradepartmental collaborations, the department does have collaborations with PGIMER (CHD), CSIR-IMTECH (CHD), CSIR-IHBT (Palampur). The faculty of the department has been conferred awards/recognition at various platforms nationally. The department offers B.Sc. (H.S.), M.Sc. (H.S.) and PhD programme. With respect to the placements, the students of the department either go abroad to pursue doctoral / post-doctoral training or join industry/ premier research institutes and universities of the country. The students completing B.Sc (Hons School) in Microbiology are automatically admitted to M.Sc. (Hons School) in Microbiology.

The vision of the department is to explore Microbial diversity in Health, Industry and Environment with the mission to use Microbiology in the Service of Society.
## COURSE STRUCTURE

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**C**: Core Courses; **GE**: General Elective; **AECC**: Ability Enhancement Compulsory Courses; **SEC**: Skill Enhancement Courses; **DSE**: Discipline Specific Elective

*GE subjects are to be selected by the students from the pool of GE Subjects offered by various Departments of the University.*
**SKILL ENHANCEMENT COURSES (any one per semester in semesters 3-4)**

MIC-SE1: Microbial Quality Control in Food and Pharmaceutical Industries  
MIC-SE2: Microbial Diagnosis in Health Clinics  
MIC-SE3: Biofertilizers and Biopesticides  
MIC-SE4: Food Fermentation Techniques  
MIC-SE5: Management of Human Microbial Diseases  
MIC-SE6: Microbiological Analysis of Air and Water

**DISCIPLINE CENTRIC SUBJECTS (any two per semester in semesters 5-6)**

MIC- DSE1: Bioinformatics  
MIC- DSE2: Microbial Biotechnology  
MIC- DSE3: General Pathology  
MIC- DSE4: Biomathematics and Biostatistics  
MIC- DSE5: Microbes in Sustainable Agriculture and Development  
MIC- DSE6: Biosafety and Intellectual Property Rights  
MIC- DSE7: Instrumentation and Biotechniques  
MIC- DSE8: Project Work

**Courses under these will be offered only if a minimum of 10 students opt for the same**

**GENERIC ELECTIVE SUBJECTS (Offered by Microbiology Department) for students of other departments**

MIC- GE1*: General Bacteriology  
MIC- GE2*: Industrial Microbiology  
MIC- GE3*: Environmental Microbiology  
MIC- GE4*: Food and Dairy Microbiology  
MIC- GE5*: Microbial and Molecular Genetics  
MIC- GE6*: Virology

**Outlines for Semester II will be same as for Semester I**

A Department will run a particular Generic Elective Course only if the minimum number of students opting for that course is 10.
OUTLINES OF TESTS
OBJECTIVE OF THE COURSE

To teach the fundamental concepts of Microbiology and their applications. The syllabus pertaining to B.Sc. (Honours) Microbiology (3 Year course & 6 Semesters) in the subject of Microbiology under Honours School Framework has been upgraded as per provision of the UGC module for CHOICE BASED CREDIT SYSTEM and demand of the academic environment. The syllabus contents are duly arranged unit wise and contents are included in such a manner so that due importance is given to requisite intellectual and laboratory skills according to UGC module for CHOICE BASED CREDIT SYSTEM pertaining to B.Sc. Honours (Microbiology).

**Semester I**

**CORE COURSE (MICROBIOLOGY)**

**Theory Papers:**
- Core Course-1 MIC-(C 1): Biomolecules (To be taught by Deptt. Of Biochemistry) 100 Marks (4 credits)
- Core Course-2 MIC-(C 2): Cell Biology (To be taught by Deptt. Of Biophysics) 100 Marks (4 credits)

**Practicals:**
- Core Course-1 Practical (C 1 Lab): 50 Marks (2 credits)
- Core Course-2 Practical (C 2 Lab): 50 Marks (2 credits)

**GENERIC ELECTIVE (MICROBIOLOGY)**

Each student from other disciplines may opt any two of the generic electives offered by the Science Departments of Panjab University out of following:

**Theory Papers:**
- Generic Elective -1 (GE-1) 100 Marks (4 credits)
- Generic Elective -2 (GE-2) 100 Marks (4 credits)

**Practicals:**
- Generic Elective -1 Practical (GE-1 Lab) 50 Marks (2 credits)
- Generic Elective -2 Practical (GE-2 Lab) 50 Marks (2 credits)

**SEMESTER II**

**CORE COURSE (MICROBIOLOGY)**

**Theory Papers:**
- Core Course-1 MIC-(C 3): General Microbiology 100 Marks (4 credits)
- Core Course-2 MIC-(C 4): Molecular Biology (To be taught by Deptt. Of Biotechnology) 100 Marks (4 credits)

**Practicals:**
- Core Course-1 Practical (C 3 Lab): 50 Marks (2 credits)
- Core Course-2 Practical (C 4 Lab): 50 Marks (2 credits)
GENERIC ELECTIVE (MICROBIOLOGY)
Each student from other disciplines may opt any two of the generic electives offered by the Science Departments of Panjab University out of following:

**Theory Papers:**
- Generic Elective -1 (GE-3) 100 Marks (4 credits)
- Generic Elective -2 (GE-4) 100 Marks (4 credits)

**Practicals:**
- Generic Elective -1 Practical (GE-3 Lab) 50 Marks (2 credits)
- Generic Elective -2 Practical (GE-4 Lab) 50 Marks (2 credits)

Four core courses in first year will run simultaneously in both semesters under PU-IMBSER
A Department will run a particular Generic Elective Course only if the minimum number of students opting for the course is 10.

**EVALUATION**

1. There shall be one Mid Term Examination of 20% Marks (20 marks) in each semester.
2. End-semester examination will be of 80% of total marks (80 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks (10 marks). The final examination will be of 80% marks (40 marks).
5. Pattern of end-semester question paper

(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions
(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus. There will be no choice in this question.
(iii) The remaining eight questions will have Four Units comprising two questions from each Unit.
(iv) Students will attempt one question from each unit and the compulsory question.

ABILITY ENHANCEMENT COMPULSORY COURSE FOR MICROBIOLOGY STUDENTS
Each student of Microbiology Department has to opt one Ability Enhancement Compulsory Course of the following:

1. English Communication (2 credits)
2. Environmental Science (2 credits)
Core Course for Semester I/II
ABC –C1: (Biomolecules) - To be taught by the Department of Biochemistry
THEORY

Total Lectures : 60                                                                                         Credits : 4

Objective: (Brief outline)

UNIT 1: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 2: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 3: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 4: (Title of Unit)                                       (... hrs)
........................................Contents of the Unit..............................

Semester I
ABC-C2: (Cell Biology)  - To be taught by the Department of Biophysics
THEORY

Total Lectures : 60                                                                                        Credits : 4

Objective: (Brief outline)

UNIT 1: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 2: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 3: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................

UNIT 4: (Title of Unit)                                      (... hrs)
........................................Contents of the Unit..............................
ABC -C1: (Name of Subject)
PRACTICALS

Total Lectures : 60                                                                                         Credits : 2

1. (Aim of practical)
2. (Aim of practical)
3.
4.
5.
6.

SUGGESTED READING
(Mention at least 4 Books in the style given below)
For example

ABC -C2: (Name of Subject)
PRACTICALS

Total Lectures : 60                                                                                         Credits : 2

1. (Aim of practical)
2. (Aim of practical)
3.
4.
5.
6.

SUGGESTED READING
(Mention at least 4 Books in the style given below)
For example
Core Course for Semester I/II
MIC-C3: (General Microbiology)
THEORY

Total Lectures : 60                                                                                             Credits : 4

Objective : To give an overview of fundamental and applied aspects of microbiology viz. history, microbial world and its diversity, taxonomy nomenclature, growth kinetics, metabolism, microbial genetics, antimicrobial agents and role of microorganisms in human health, environment, food and industries.

UNIT 1 : (Introduction of Microbiology and Microbial Systematics) (15 Hours)

History and Development of Microbiology as a discipline, Scope and relevance


Systems of classification:
Binomial Nomenclature, Whittaker’s five kingdom and Carl Woese’s three kingdom classification systems and their utility. Numerical taxonomy, Phylogenetic and serotype classification. Difference between prokaryotic and eukaryotic microorganisms

UNIT 2 : (Diversity of Microbial World) (15 Hours)

General characteristics of different microbes groups:

Acellular microorganisms (Viruses, Viroids, Prions)
Cellular microorganisms

2a Bacteria: Characteristics of bacteria and occurrence: Prokaryotic bacterial cell structure and function; nutrition; growth kinetics. General principles of bacterial genetics, mutations, gene transfer and recombination

2b Algae: General characteristics of algae including occurrence, structure, reproduction. Applications in agriculture, industry, environment and food.

2c Fungi: General characteristics of fungi including habitat, distribution, nutritional requirements, fungal cell ultra-structure, reproduction and applications in industry, agriculture, environment and food

2d Protozoa: General characteristics with special reference to Amoeba, Paramecium, Plasmodium, Leishmania and Giardia.

UNIT 3 : (Microbes in Human Health & Environment) (15 Hours)

Medically important pathogens & beneficial microorganism: Normal microflora of human body & its role in health. Causative agents for common human diseases, beneficial microorganisms counter acting the human pathogens and their interaction with the host. Antimicrobial chemotherapy: Drugs and their mechanism of action, antibiotic resistance and its transmission.

Environmental microbiology: Important microbial interactions – mutualism, commensalism, parasitism. microorganisms used as biopesticides, biofertilizers, in biodegradation, biodeterioration and bioremediation (e.g. hydrocarbons in oil spills). Water, air and sewage microbiology-an overview.

UNIT 4 : Microbes in Industry and Foods (15 Hours)

Industrial Microbiology: Primary and secondary metabolites, types of fermentations and microbes producing important industrial products through fermentations. Batch, continuous and fed-batch cultivation. Genetic engineering of industrial microbes.

Food and Dairy Microbiology: Microorganisms as food (SCP), microorganisms in food fermentations (dairy and non dairy based fermented food products) and probiotics. Microorganisms in food spoilage and food borne infections.
MIC-C3: General Microbiology
PRACTICALS

Total Lectures : 60  
CRedits : 2

1. General Introduction and familiarization to important microbiological instruments in the laboratories.
2. Introduction to microscopes and their working.
3. Microorganisms are ubiquitous: Finger printing.
4. Introduction to sterilization: Dry heat and moist heat and filtration.
5. Simple staining, Gram staining, Negative staining, Cell wall staining, Capsule staining, Flagellar staining, Acid Fast staining, Spore staining.
6. Preparation of media (nutrient broth and nutrient agar) for the growth of microorganisms.
7. General Methods: Pour plating, Spread plating, Streaking and Dilutions.
8. Determine the size of bacteria.
9. Motility of bacteria: Hanging Drop and Soft Agar
10. Isolation of microorganisms from different sources: Soil, Curd, Root nodules, Sore throat.
11. Bacterial CFUs in mineral water bottle.
12. Phenol Coefficient: To study the antibacterial effect of various chemical compounds.
13. To study the antibacterial effect of antibiotics.

SUGGESTED READING

Core Course for Semester I/II

ABC -C4: (Molecular Biology) - To be taught by the Department of Biotechnology

THEORY

Total Lectures : 60                                                                                          Credits : 4

Objective: (Brief outline)

UNIT 1: (Title of Unit)                                      (... hrs)

.................................Contents of the Unit.................................

UNIT 2: (Title of Unit)                                      (... hrs)

.................................Contents of the Unit.................................

UNIT 3: (Title of Unit)                                      (... hrs)

.................................Contents of the Unit.................................

UNIT 4: (Title of Unit)                                      (... hrs)

.................................Contents of the Unit.................................

ABC -C4: (Name of Subject)

PRACTICALS

Total Lectures : 60                                                                                        Credits : 2

1. (Aim of practical)
2. (Aim of practical)
3.
4.
5.
6.

SUGGESTED READING
(Mention atleast 4 Books in the style given below)

For example

MIC-GE1: (GENERAL BACTERIOLOGY)  
THEORY

Total Lectures: 60  
Credits: 4

Objectives: The course is designed to introduce the students a broad view of bacterial systems i.e., cell organization, systematics, growth, nutrition, reproduction and important archaeal and eubacterial groups and microscopy.

UNIT 1 (Cell organization)  
(15 Hours)

Cell size, shape and arrangement, glyocalyx, capsule, flagella, endoflagella, fimbriae and pili.  
**Cell-wall:** Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Gram and acid fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Effect of antibiotics and enzymes on the cell wall.  
**Cell Membrane:** Structure, function and chemical composition of bacterial and archaeal cell membranes.  
**Cytoplasm:** Ribosomes, mesosomes, inclusion bodies, nucleoid, chromosome and plasmids  
**Endospore:** Structure, formation, stages of sporulation.

UNIT 2 (Bacterial Systematics)  
(15 Hours)

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences.

**Bacteriological techniques**  
Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

**Microscopy**  
Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

UNIT 3 (Growth and nutrition)  
(15 Hours)

Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media  
**Physical methods of microbial control:** heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation  
**Chemical methods of microbial control:** disinfectants, types and mode of action

**Reproduction in Bacteria**  
Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate  
Differences between eubacteria and archaeabacteria

UNIT 4 (Important archaeal and eubacterial groups)  
(15 Hours)

**Archaebacteria:** General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (*Nanoarchaeum*), Crenarchaeota (*Sulfolobus, Thermoproteus*) and Euryarchaeota [Methanogens (*Methanobacterium, Methanocaldococcus*), thermophiles (*Thermococcus, Pyrococcus, Thermoplasma*), and Halophiles (*Halobacterium, Halococcus*)]
Eubacteria: Morphology, metabolism, ecological significance and economic importance of following groups:

**Gram Negative:**
- Non proteobacteria: General characteristics with suitable examples Alpha proteobacteria: General characteristics with suitable examples Beta proteobacteria: General characteristics with suitable examples Gamma proteobacteria: General characteristics with suitable examples Delta proteobacteria: General characteristics with suitable examples Epsilon proteobacteria: General characteristics with suitable examples Zeta proteobacteria: General characteristics with suitable examples

**Gram Positive:**
- Low G+ C (Firmicutes): General characteristics with suitable examples High G+C (Actinobacteria): General characteristics with suitable examples

**Cyanobacteria:** An Introduction

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**MIC- GE1: (GENERAL BACTERIOLOGY) PRACTICALS**

**Total Lectures: 60**

1. Preparation of different media: synthetic media BG-11, Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram’s staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
11. Motility by hanging drop method.

**SUGGESTED READINGS**

Objectives: The course has been designed to make the students understand the commercial exploitation of microorganisms, their processes and product in various industries, techniques to harness microbial products by the process of fermentation (upstream & downstream processings). The course also deals with the strain improvement, isolation, acquisition, maintenance & long and short term preservation of industrially important microbial cultures and various bioreactor types & configurations.

UNIT 1 (Introduction to industrial microbiology) (15 Hours)
History and developments in industrial microbiology
Isolation of industrially important microbial strains and fermentation media
Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn- steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

UNIT 2 (Types of fermentation processes, bio-reactors and measurement of fermentation parameters) (15 Hours)
Types of fermentation processes - Solid-state and liquid-state (stationary and submerged), fermentations; batch, fed-batch (eg. baker’s yeast) and continuous fermentations Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

UNIT 3 (Down-stream processing) (15 Hours)
Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

CELL and Enzyme immobilization
Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes  (glucose isomerase and penicillin acylase)

UNIT 4 (Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses) (15 Hours)
Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12
Enzymes (amylase, protease, lipase) Wine, beer

MIC-GE2: (INDUSTRIAL MICROBIOLOGY)
PRACTICALS

Total Lectures: 60 Credits: 2
1. Study different parts of fermenter
2. Microbial fermentations for the production and estimation (qualitative and quantitative) of: (a) Enzymes: Amylase and Protease
(b) Amino acid: Glutamic acid
(c) Organic acid: Citric acid
(d) Alcohol: Ethanol
3. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations
MIC- GE3 (ENVIRONMENTAL MICROBIOLOGY)
THEORY

Total Lectures: 60  Credits: 4

Objective: The objective of the course is to teach the various microbial environments encountered in the area of soil water and air microbiology and how they affect the cycling of nutrients, various methods available for identification and enumeration of microbes in these environments.

UNIT-I (15 Hours)


UNIT-II (15 Hours)

Microbial biodegradation of petroleum products in terrestrial, aquatic environment. Problems related to SO\textsubscript{4}, reducing bacteria in petroleum industries and their metabolism, ecology and physiology. Treatment and disposal of petroleum refinery waste. Heavy crude and oil shale. Recovery of petroleum from oil bearing rocks.

UNIT-III (15 Hours)

Microbiology of air: Exhaust gas purification, Methods of waste gas treatment, aerosols monitoring, Bioreactors for Volatile organic compounds and odours. Sewage & water treatment: Significance of microorganisms present in sewage & water BOD mechanisms & kinetics, BOD in design and operation of biological treatment. BOD as an aid in regulation of water quality

UNIT-IV (15 Hours)


MIC- GE3: (ENVIRONMENTAL MICROBIOLOGY)
PRACTICALS

Total Lectures: 60  Credits: 2

1. Presumptive test for coliform group of bacteria.
2. Confirmed test of coliform bacteria.
3. To study the micro-flora of air (indoor and outdoor.
4. Isolation of anaerobic bacteria by candle jar method.
5. To study the micro-flora of soil by slide buried technique.
6. Isolation of phosphate solubilizing micro-organism from soil and water.
7. Water analysis for total bacterial population by standard plate count (SPC) method.
10. Determination of biological oxygen demand (BOD) of water (raw/treated sewage).
11. Determination of chemical oxygen demand (COD) of water (raw/treated sewage).
12. Determination of total alkalinity of water.
SUGGESTED READINGS

2. Environmental Microbiology by Ian Papper and Charles Gerba, Elsevier Press 2008
3. Environmental Microbiology by P.D.Sharma, Alpha Science International, 2005
5. Environmental microbiology by A.H. Varnam and M. Evans Blackwill Publisher 2000
6. Comprehensive Biotechnology by Moo Young. 1995

JOURNALS

2. Applied and Environmental Microbiology.
5. Environmental Microbiology Reports
Objectives: This course has been designed with objectives to impart knowledge to the students on involvement of various microorganisms in causing diseases, spoilage, their role as source of foods and fermented foods. Besides, it also gives the knowledge in depth regarding various food preservation and analysis methods and various food sanitation methods and standards to assure the quality control for food safety.

UNIT 1 (Foods as a substrate for microorganisms) (15 Hours)
Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Microbial spoilage of various foods
Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

UNIT 2 (Principles and methods of food preservation) (15 Hours)
Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

UNIT3 (Fermented foods) (15 Hours)
Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology.

UNIT 4 Food borne diseases (causative agents, foods involved, symptoms and preventive measures) (15 Hours)
Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins;
Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Food sanitation and control
HACCP, Indices of food sanitary quality and sanitizers

MIC-GE4: (FOOD AND DAIRY MICROBIOLOGY)
PRACTICALS
Total Lectures : 60
Credits : 2
1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.
SUGGESTED READINGS


Semester III

CORE COURSE (MICROBIOLOGY)

Theory Papers:
Core Course-1 (C 5): 100 Marks (4 credits)
Core Course-2 (C 6): 100 Marks (4 credits)
Core Course-3 (C 7): 100 Marks (4 credits)

Practicals:
Core Course-1 Practical (C 5 Lab): 50 Marks (2 credits)
Core Course-2 Practical (C 6 Lab): 50 Marks (2 credits)
Core Course-3 Practical (C 7 Lab): 50 Marks (2 credits)

GENERIC ELECTIVE (MICROBIOLOGY)

Each student from other disciplines may opt any two of the generic electives offered by the Science Departments of Panjab University out of following:

Theory Papers:
Generic Elective -1 (GE-5) 100 Marks (4 credits)

Practicals:
Generic Elective -1 Practical (GE-5 Lab) 50 Marks (2 credits)

SKILL ENHANCEMENT COURSES (MICROBIOLOGY)

Skill Enhancement Courses (SEC-1) 50 Marks (2 credits)

EVALUATION

1. There shall be one Mid Term Examination of 20% Marks (20 marks) in each semester.
2. End-semester examination will be of 80% of total marks (80 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks (10 marks). The final examination will be of 80% marks (40 marks).

Pattern of end-semester question paper

(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions
(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus.
(iii) There will be no choice in this question.
(iv) The remaining eight questions will have Four Units comprising two questions from each Unit.
(v) Students will attempt one question from each unit and the compulsory question.
Semester III

MIC-C5: (GENERAL BACTERIOLOGY)

Total Lectures: 60 Credits: 4

Objectives: The course is designed to introduce the students a broad view of bacterial systems i.e., cell organization, systematics, growth, nutrition, reproduction and important archaeal and eubacterial groups and microscopy.

UNIT 1 (Cell organization) (15 Hours)


UNIT 2 (Bacterial Systematics) (15 Hours)

Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain; conventional, molecular and recent approaches to polyphasic bacterial taxonomy, evolutionary chronometers, rRNA oligonucleotide sequencing, signature sequences, and protein sequences. Bacteriological techniques

Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and preservation/stocking of pure cultures; cultivation of anaerobic bacteria, and accessing non-culturable bacteria.

Microscopy

Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope, Fluorescence Microscope, Confocal microscopy, Scanning and Transmission Electron Microscope

UNIT 3 (Growth and nutrition) (15 Hours)

Nutritional requirements in bacteria and nutritional categories; Culture media: components of media, natural and synthetic media, chemically defined media, complex media, selective, differential, indicator, enriched and enrichment media Physical methods of microbial control: heat, low temperature, high pressure, filtration, desiccation, osmotic pressure, radiation Chemical methods of microbial control: disinfectants, types and mode of action

Reproduction in Bacteria

Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate. Differences between eubacteria and archaeabacteria

UNIT 4 (Important archaeal and eubacterial groups) (15 Hours)

Archaeabacteria: General characteristics, phylogenetic overview, genera belonging to Nanoarchaeota (Nanoarchaeum), Crenarchaeota (Sulfolobus, Thermoproteus) and Euryarchaeota [Methanogens (Methanobacterium, Methanothermobacter), thermophiles (Thermococcus, Pyrococcus, Thermoplasma), and Halophiles (Halobacterium, Halococcus)]
**Eubacteria:** Morphology, metabolism, ecological significance and economic importance of following groups:

**Gram Negative:**
Non proteobacteria: General characteristics with suitable examples Alpha proteobacteria: General characteristics with suitable examples Beta proteobacteria: General characteristics with suitable examples Gamma proteobacteria: General characteristics with suitable examples Delta proteobacteria: General characteristics with suitable examples Epsilon proteobacteria: General characteristics with suitable examples Zeta proteobacteria: General characteristics with suitable examples **Gram Positive:**
Low G+ C (Firmicutes): General characteristics with suitable examples High G+C (Actinobacteria): General characteristics with suitable examples

**Cyanobacteria:** An Introduction

**MIC- C5: (GENERAL BACTERIOLOGY) PRACTICALS**

**Total Lectures: 60**

**Credits: 2**

1. Preparation of different media: synthetic media BG-11, Complex media-Nutrient agar, McConkey agar, EMB agar.
2. Simple staining
3. Negative staining
4. Gram’s staining
5. Acid fast staining-permanent slide only.
6. Capsule staining
7. Endospore staining.
8. Isolation of pure cultures of bacteria by streaking method.
9. Preservation of bacterial cultures by various techniques.
11. Motility by hanging drop method.

**SUGGESTED READINGS**

MIC-C6: (INDUSTRIAL MICROBIOLOGY)
THEORY

Total Lectures: 60  
Credits: 4

Objectives: The course has been designed to make the students understand the commercial exploitation of microorganisms, their processes and product in various industries, techniques to harness microbial products by the process of fermentation (upstream & downstream processings). The course also deals with the strain improvement, isolation, acquisition, maintenance & long and short term preservation of industrially important microbial cultures and various bioreactor types & configurations.

UNIT 1 (Introduction to industrial microbiology)  (15 Hours)

History and developments in industrial microbiology
Isolation of industrially important microbial strains and fermentation media
Sources of industrially important microbes and methods for their isolation, preservation and maintenance of industrial strains, strain improvement, Crude and synthetic media; molasses, corn-steep liquor, sulphite waste liquor, whey, yeast extract and protein hydrolysates

UNIT 2 (Types of fermentation processes, bio-reactors and measurement of fermentation parameters)  (15 Hours)

Types of fermentation processes - Solid-state and liquid-state (stationary and submerged) fermentations; batch, fed-batch (eg. baker's yeast) and continuous fermentations
Components of a typical bio-reactor, Types of bioreactors-Laboratory, pilot- scale and production fermenters, constantly stirred tank and air-lift fermenters, Measurement and control of fermentation parameters - pH, temperature, dissolved oxygen, foaming and aeration

UNIT 3 (Down-stream processing)  (15 Hours)

Cell disruption, filtration, centrifugation, solvent extraction, precipitation, lyophilization and spray drying

Cell and Enzyme immobilization
Methods of immobilization, advantages and applications of immobilization, large scale applications of immobilized enzymes (glucose isomerase and penicillin acylase)

UNIT 4 (Microbial production of industrial products (micro-organisms involved, media, fermentation conditions, downstream processing and uses)  (15 Hours)

Citric acid, ethanol, penicillin, glutamic acid, Vitamin B12
Enzymes (amylase, protease, lipase) Wine, beer

MIC-C6: (INDUSTRIAL MICROBIOLOGY)
PRACTICALS

Total Lectures: 60  
Credits: 2

1. Study different parts of fermenter
2. Microbial fermentations for the production and estimation (qualitative and quantititative) of: (a) Enzymes: Amylase and Protease
(b) Amino acid: Glutamic acid
(c) Organic acid: Citric acid
(d) Alcohol: Ethanol
3. A visit to any educational institute/industry to see an industrial fermenter, and other downstream processing operations

**SUGGESTED READINGS**

MIC-C7: (MICROBIAL PHYSIOLOGY AND METABOLISM)
THEORY

Total Lectures: 60  Credits: 4

Objectives: The objective of the course is to teach the various aspects of microbial metabolism, growth and kinetics so as to understand the microbial physiology. The course also deals with the mechanisms of nutrient uptake & transport and types of microbial metabolism in comprehensive way.

UNIT 1 (Microbial Growth and Effect of Environment on Microbial Growth) (15 Hours)
Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture, generation time and specific growth rate, synchronous growth, diauxic growth curve
Microbial growth in response to environment - Temperature (psychrophiles, mesophiles, thermophiles, extremophiles, thermorurics, psychrotrophs), pH (acidophiles, alkaliphiles), solute and water activity (halophiles, xerophiles, osmophilic), Oxygen (aerobic, anaerobic, microaerophilic, facultative aerobe, facultative anaerobe), barophilic.
Microbial growth in response to nutrition and energy – Autotroph/Phototroph, heterotrophy, Chemolithoautotroph, Chemolithoheterotroph, Chemoheterotroph, Chemolithotroph, photolithoautotroph, Photoorganoheterotroph.

UNIT 2 (Nutrient uptake and Transport) (15 Hours)
Passive and facilitated diffusion
Primary and secondary active transport, concept of uniport, symport and antiport
Group translocation
Iron uptake

Chemoheterotrophic Metabolism- Anaerobic respiration and fermentation
Anaerobic respiration with special reference to dissimilatory nitrate reduction (Denitrification; nitrate/nitrite and nitrate/ammonia respiration; fermentative nitrate reduction)
Fermentation - Alcohol fermentation and Pasteur effect; Lactate fermentation (homofermentative and heterofermentative pathways), concept of linear and branched fermentation pathways

UNIT 3 (Chemoheterotrophic Metabolism - Aerobic Respiration) (15 Hours)
Concept of aerobic respiration, anaerobic respiration and fermentation Sugar degradation pathways i.e. EMP, ED, Pentose phosphate pathway TCA cycle
Electron transport chain: components of respiratory chain, comparison of mitochondrial and bacterial ETC, electron transport phosphorylation, uncouplers and inhibitors

UNIT 4 (Chemolithotrophic and Phototrophic Metabolism) (15 Hours)
Introduction to aerobic and anaerobic chemolithotrophy with an example each. Hydrogen oxidation (definition and reaction) and methanogenesis (definition and reaction)
Introduction to phototrophic metabolism - groups of phototrophic microorganisms, anoxygenic vs. oxygenic photosynthesis with reference to photosynthesis in green bacteria, purple bacteria and cyanobacteria

Nitrogen Metabolism - an overview
Introduction to biological nitrogen fixation
Ammonia assimilation
Assimilatory nitrate reduction, dissimilatory nitrate reduction, denitrification
1. Study and plot the growth curve of *E. coli* by turbidometric and standard plate count methods.
2. Calculations of generation time and specific growth rate of bacteria from the graph plotted with the given data.
3. Effect of temperature on growth of *E. coli*.
4. Effect of pH on growth of *E. coli*.
5. Effect of carbon and nitrogen sources on growth of *E. coli*.
6. Effect of salt on growth of *E. coli*.
7. Demonstration of alcoholic fermentation.
8. Demonstration of the thermal death time and decimal reduction time of *E. coli*.

**SUGGESTED READINGS**

Semester III/IV

**MIC-SE1: (Microbial Quality Control in Food and Pharmaceutical Industries)**
(Exercises will be done based on the following topics)

**Total Lectures : 30**  
**Credits : 2**

**Objectives:** The course gives an overview of good laboratory practices performed in microbiological laboratories, methods for determination of pathogenic microbes in food, water and pharmaceutical samples and various microbial standards to maintain the product quality.

**UNIT 1(Microbiological Laboratory and Safe Practices)**

Good laboratory practices - Good laboratory practices, Good microbiological practices

**UNIT 2 (Determining Microbes in Food / Pharmaceutical Samples) (7½ Hours)**

Culture and microscopic methods - Standard plate count, Most probable numbers, Direct microscopic counts, Biochemical and immunological methods: Limulus lysate test for endotoxin, gel diffusion, sterility testing for pharmaceutical products
Molecular methods - Nucleic acid probes, PCR based detection, biosensors.

**UNIT 3 (Pathogenic Microorganisms of Importance in Food & Water) (7½ Hours)**

Enrichment culture technique, Detection of specific microorganisms - on XLD agar, Salmonella Shigella Agar, Manitol salt agar, EMB agar, McConkey Agar, Sabouraud Agar
Ascertaining microbial quality of milk by MBRT, Rapid detection methods of microbiological quality of milk at milk collection centres (COB, 10 min Resazurin assay)

**UNIT 4 (HACCP for Food Safety and Microbial Standards) (7½ Hours)**

Hazard analysis of critical control point (HACCP) - Principles, flow diagrams, limitations
Microbial Standards for Different Foods and Water – BIS standards for common foods and drinking water

**SUGGESTED READING**

Objective: The objective of the course is to introduce the students to basic and applied aspects of microbial genetics. The students are given a thorough understanding of recombinant DNA technology and guidelines. This prepares them for further advances courses.

UNIT-I (15 Hours)

UNIT-II (15 Hours)
Vectors- plasmids, lambda phage structure, biology and derivatives as vectors, in vitro packaging, cosmids, phagemids, P1, PAC, BAC, YAC and M13 vectors, restriction enzymes, types, restriction and modification systems of bacteria, restriction and generalized mapping, RFLP

UNIT-III (15 Hours)
Gene technology & implications: Gene cloning: genomic and cDNA library construction, subtractive cDNA library, PCR, RT-PCR, Real time PCR, ligation theory, transformation by CaCl₂, electroporation, biolistics; screening of cloned transformants – autoradiography, hybridization, non-radioactive methods; in vitro protein synthesis.

UNIT-IV (15 Hours)
Oligonucleotide mediated site directed mutagenesis. ; DNA sequencing- Sanger, Maxam-Gilbert, capillary, on chip, pyrosequencing. streptomycetes genetics; NIH guidelines on the genetic engineering experiments, fungal (yeast) genetic, protoplast fusion.
MIC-GE5 MICROBIAL AND MOLECULAR GENETICS
PRACTICALS

Total Lectures: 60
Credits: 2

1. Isolation and purification of plasmid DNA using alkaline lysis method.
2. Isolation and purification of plasmid DNA using boiling prep method.
3. Isolation of bacterial chromosomal DNA
4. To check the purity and the quantification of DNA by using spectrophotometric method.
5. Transformation of E.coli with plasmid using calcium chloride treatment
6. Transformation of E.coli by electroporation.
7. To induce the mutations by (a) chemical mutagens like EMS
   (b) Physical agents like U.V light
8. Hfr x F⁻ conjugation to map genes.

SUGGESTED READING
Semester IV

CORE COURSE (MICROBIOLOGY)

Theory Papers:
Core Course-1 (C 8): 100 Marks (4 credits)
Core Course-2 (C 9): 100 Marks (4 credits)
Core Course-3 (C 10): 100 Marks (4 credits)

Practicals:
Core Course-1 Practical (C 8 Lab): 50 Marks (2 credits)
Core Course-2 Practical (C 9 Lab): 50 Marks (2 credits)
Core Course-2 Practical (C 10 Lab): 50 Marks (2 credits)

GENERIC ELECTIVE (MICROBIOLOGY)

Each student from other disciplines may opt any two of the generic electives offered by the Science Departments of Panjab University out of following:

Theory Papers:
Generic Elective -1 (GE-6) 100 Marks (4 credits)

Practicals:
Generic Elective -1 Practical (GE-6 Lab) 50 Marks (2 credits)

SKILL ENHANCEMENT COURSES (MICROBIOLOGY)

Skill Enhancement Courses (SEC-2) 50 Marks (2 credits)

EVALUATION
1. There shall be one Mid Term Examination of 20% Marks (20 marks) in each semester.
2. End-semester examination will be of 80% of total marks (80 marks).
3. Each practical examination shall be of 3 hours duration.
4. There shall be continuous internal assessment for practicals of 20% marks (10 marks). The final examination will be of 80% marks (40 marks).

Pattern of end-semester question paper

(i) Nine questions in all with equal weightage (16 marks). The candidate will be asked to attempt five questions
(ii) One Compulsory question (consisting of short answer type questions) covering whole syllabus.
(iii) There will be no choice in this question.
(iv) The remaining eight questions will have Four Units comprising two questions from each Unit.
(v) Students will attempt one question from each unit and the compulsory question.
Semester IV

MIC-C8: (ENVIRONMENTAL MICROBIOLOGY)
THEORY

Total Lectures: 60  Credits: 4

Objectives: The objective of the course is to teach the various microbial environments encountered in the area of soil water and air microbiology and how they affect the biogeochemical cycling of nutrients. The course also deals with the types of interactions among microbes, plants and animals along with waste management strategies including microbial bioremediation techniques and various aspects of treatment and safety of potable water.

UNIT 1 (Microorganisms and their Habitats)  (15 Hours)

Structure and function of ecosystems
Terrestrial Environment: Soil profile and soil microflora
Aquatic Environment: Microflora of fresh water and marine habitats
Atmosphere: Aeromicroflora and dispersal of microbes
Animal Environment: Microbes in/on human body (Microbiomics) & animal (ruminants) body. Extreme Habitats: Extremophiles: Microbes thriving at high & low temperatures, pH, high hydrostatic & osmotic pressures, salinity, & low nutrient levels.
Microbial succession in decomposition of plant organic matter

UNIT 2 (Microbial Interactions)  (15 Hours)

Microbe interactions: Mutualism, synergism, commensalism, competition, amensalism, parasitism, predation
Microbe-Plant interaction: Symbiotic and non symbiotic interactions
Microbe-animal interaction: Microbes in ruminants, nematophagus fungi and symbiotic luminescent bacteria

Biogeochemical Cycling
Carbon cycle: Microbial degradation of cellulose, hemicelluloses, lignin and chitin
Nitrogen cycle: Nitrogen fixation, ammonification, nitrification, denitrification and nitrate reduction
Phosphorus cycle: Phosphate immobilization and solubilisation
Sulphur cycle: Microbes involved in sulphur cycle
Other elemental cycles: Iron and manganese

UNIT 3 (Waste Management)  (15 Hours)

Solid Waste management: Sources and types of solid waste, Methods of solid waste disposal (composting and sanitary landfill)
Liquid waste management: Composition and strength of sewage (BOD and COD), Primary, secondary (oxidation ponds, trickling filter, activated sludge process and septic tank) and tertiary sewage treatment

UNIT 4 (Microbial Bioremediation)  (15 Hours)

Principles and degradation of common pesticides, organic (hydrocarbons, oil spills) and inorganic (metals) matter, biosurfactants

Water Potability
Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a) standard qualitative procedure: presumptive test/MPN test, confirmed and completed tests for faecal coliforms (b) Membrane filter technique and (c) Presence/absence tests
MIC-C8: (ENVIRONMENTAL MICROBIOLOGY) PRACTICALS

Total Lectures: 60

Credits : 2

1. Analysis of soil - pH, moisture content, water holding capacity, percolation, capillary action.
2. Isolation of microbes (bacteria & fungi) from soil (28°C & 45°C).
3. Isolation of microbes (bacteria & fungi) from rhizosphere and rhizoplane.
4. Assessment of microbiological quality of water.
5. Determination of BOD of waste water sample.
6. Study the presence of microbial activity by detecting (qualitatively) enzymes (dehydrogenase, amylase, urease) in soil.
7. Isolation of Rhizobium from root nodules.

SUGGESTED READINGS

Semester IV

MIC-C9: (MEDICAL MICROBIOLOGY)

THEORY

Total Lectures: 60    Credits: 4

Objectives: The objective of the course is to introduce the students to types of normal microflora associated with human body, their interactions and methods to study them. Besides, the course deals with the types of microbial diseases, including bacterial, viral, protozoan, and fungal diseases, their pathogenesis, transmission, prophylaxis and treatment methods. It also deals with antimicrobial agents their characteristics and mode of action.

UNIT1 (Normal microflora of the human body and host pathogen interaction) (15 Hours)

Normal microflora of the human body: Importance of normal microflora, normal microflora of skin, throat, gastrointestinal tract, urogenital tract
Host pathogen interaction: Definitions - Infection, Invasion, Pathogen, Pathogenicity, Virulence, Toxigenicity, Carriers and their types, Opportunistic infections, Nosocomial infections. Transmission of infection, Pathophysiological effects of LPS

Sample collection, transport and diagnosis
Collection, transport and culturing of clinical samples, principles of different diagnostic tests (ELISA, Immunofluorescence, Agglutination based tests, Complement fixation, PCR, DNA probes).

UNIT 2 (Bacterial diseases) (15 Hours)

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control
Respiratory Diseases: *Streptococcus pyogenes, Haemophilus influenzae, Mycobacterium tuberculosis*
Gastrointestinal Diseases: *Escherichia coli, Salmonella typhi, Vibrio cholerae, Helicobacter pylori* Others: *Staphylococcus aureus, Bacillus anthracis, Clostridium tetani, Treponema pallidum, Clostridium difficile*

UNIT 3 (Viral diseases) (15 Hours)

List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control
Polio, Herpes, Hepatitis, Rabies, Dengue, AIDS, Influenza with brief description of swine flu, Ebola, Chikungunya, Japanese Encephalitis

Protozoan diseases
List of diseases of various organ systems and their causative agents. The following diseases in detail with Symptoms, mode of transmission, prophylaxis and control
Malaria, Kala-azar

UNIT (Fungal diseases) (15 Hours)

Brief description of each of the following types of mycoses and one representative disease to be studied with respect to transmission, symptoms and prevention
Cutaneous mycoses: Tinea pedis (Athlete’s foot) Systemic mycoses: Histoplasmosis
Opportunistic mycoses: Candidiasis

Antimicrobial agents: General characteristics and mode of action
Antibacterial agents: Five modes of action with one example each: Inhibitor of nucleic acid synthesis; Inhibitor of cell wall synthesis; Inhibitor of cell membrane function; Inhibitor of protein synthesis; Inhibitor of metabolism
Antifungal agents: Mechanism of action of Amphotericin B, Griseofulvin
Antiviral agents: Mechanism of action of Amantadine, Acyclovir, Azidothymidine
Antibiotic resistance, MDR, XDR, MRSA, NDM-1
Semester IV

MIC-C9: (MEDICAL MICROBIOLOGY)
PRACTICALS

Total Lectures : 60 Credits : 2

1. Identify bacteria (any three of *E. coli, Salmonella, Pseudomonas, Staphylococcus, Bacillus*) using laboratory strains on the basis of cultural, morphological and biochemical characteristics: IMViC, TSI, nitrate reduction, urease production and catalase tests
2. Study of composition and use of important differential media for identification of bacteria: EMB Agar, McConkey agar, Mannitol salt agar, Deoxycholate citrate agar, TCBS
3. Study of bacterial flora of skin by swab method
4. Perform antibacterial sensitivity by Kirby-Bauer method
5. Determination of minimal inhibitory concentration (MIC) of an antibiotic.
6. Study symptoms of the diseases with the help of photographs: Polio, anthrax, herpes, chicken pox, HPV warts, AIDS (candidiasis), dermatomycoses (ring worms)
7. Study of various stages of malarial parasite in RBCs using permanent mounts.

SUGGESTED READING

Semester IV

MIC-C10: (FOOD AND DAIRY MICROBIOLOGY)

THEORY

Total Lectures : 60  Credits: 4

Objectives: This course has been designed with objectives to impart knowledge to the students on involvement of various microorganisms in causing diseases, spoilage, their role as source of foods and fermented foods. Besides, it also gives the knowledge in depth regarding various food preservation and analysis methods and various food sanitation methods and standards to assure the quality control for food safety.

UNIT 1 (Foods as a substrate for microorganisms)  

(15 Hours)

Intrinsic and extrinsic factors that affect growth and survival of microbes in foods, natural flora and source of contamination of foods in general.

Microbial spoilage of various foods
Principles, Spoilage of vegetables, fruits, meat, eggs, milk and butter, bread, canned Foods

UNIT 2 (Principles and methods of food preservation)  

(15 Hours)

Principles, physical methods of food preservation: temperature (low, high, canning, drying), irradiation, hydrostatic pressure, high voltage pulse, microwave processing and aseptic packaging, chemical methods of food preservation: salt, sugar, organic acids, SO2, nitrite and nitrates, ethylene oxide, antibiotics and bacteriocins

UNIT 3 (Fermented foods)  

(15 Hours)

Dairy starter cultures, fermented dairy products: yogurt, acidophilus milk, kumiss, kefir, dahi and cheese, other fermented foods: dosa, sauerkraut, soy sauce and tampeh, Probiotics: Health benefits, types of microorganisms used, probiotic foods available in market.

Cultural and rapid detection methods of food borne pathogens in foods and introduction to predictive microbiology.

UNIT 4 Food borne diseases (causative agents, foods involved, symptoms and preventive measures)  

(15 Hours)

Food intoxications: Staphylococcus aureus, Clostridium botulinum and mycotoxins;
Food infections: Bacillus cereus, Vibrio parahaemolyticus, Escherichia coli, Salmonellosis, Shigellosis, Yersinia enterocolitica, Listeria monocytogenes and Campylobacter jejuni

Food sanitation and control

HACCP, Indices of food sanitary quality and sanitizers
Semester IV
MIC-C10: (FOOD AND DAIRY MICROBIOLOGY)
PRACTICALS

Total Lectures : 60  Credits : 2

1. MBRT of milk samples and their standard plate count.
2. Alkaline phosphatase test to check the efficiency of pasteurization of milk.
3. Isolation of any food borne bacteria from food products.
4. Isolation of spoilage microorganisms from spoiled vegetables/fruits.
5. Isolation of spoilage microorganisms from bread.

SUGGESTED READINGS

Semester IV

MIC-SE2: (MICROBIAL DIAGNOSIS IN HEALTH CLINICS)
(Exercises will be done based on the following topics)

Total Lectures : 30  Credits : 2

Objectives: The aim of the course is to give the knowledge to the students regarding importance of various microbial diagnostic approaches followed in health clinics like sample collection, examination of cultures/samples using serological, molecular methods and use of kits for rapid detection of pathogens.

UNIT 1 (Importance of Diagnosis of Diseases) (7½ Hours)

Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis.

Collection of Clinical Samples
How to collect clinical samples (oral cavity, throat, skin, Blood, CSF, urine and faeces) and precautions required. Method of transport of clinical samples to laboratory and storage.

UNIT 2 (Direct Microscopic Examination and Culture) (7½ Hours)

Examination of sample by staining - Gram stain, Ziehl-Neelson staining for tuberculosis, Giemsa-stained thin blood film for malaria
Preparation and use of culture media - Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar, Distinct colony properties of various bacterial pathogens.

UNIT 3 (Serological and Molecular Methods) (7½ Hours)

Serological Methods - Agglutination, ELISA, immunofluorescence, Nucleic acid based methods - PCR, Nucleic acid probes

UNIT 4 (Kits for Rapid Detection of Pathogens) (7½ Hours)

Typhoid, Dengue and HIV, Swine flu

Testing for Antibiotic Sensitivity in Bacteria
Importance, Determination of resistance/sensitivity of bacteria using disc diffusion method, Determination of minimal inhibitory concentration (MIC) of an antibiotic by serial double dilution method

SUGGESTED READING
Objective: The objective of this course is to give an exhaustive account of viruses, their structure, classification and diseases associated with them to the B.Sc. (H.S.) final year students. This course will prepare them for further studies and research in virology.

UNIT-I  
(15 Hours)
Introduction and general characteristics: Discovery of viruses, General morphology of viruses, viral genomes. Chemical properties of viruses, Isolation and purification of viruses.

Virus assays: Physical and chemical methods and assays based on infectivity. Comparison of different types of assays.

Classification and Nomenclature of viruses: Conventional and Baltimore classification.

Virus Multiplication: Virus multiplication and one step growth experiment. Host induced restriction and modifications.

UNIT-II  
(15 Hours)
Cultivation of viruses: Animal inoculation, inoculation in embryonated eggs and different types of cell cultures. Detection of virus growth in cell cultures.

Unconventional Agents: Satellites, viroids, prions and diseases caused by them.

Oncogenic viruses: Mechanism of viral oncogenesis and oncogenic RNA and DNA viruses.

UNIT-III  
(15 Hours)

Prevention and control measures of virus diseases: Immuno prophylaxis and chemotherapy.

UNIT-IV  
(15 Hours)
Detailed study of important groups of viruses causing diseases in man including the following groups:
Poxviruses, Herpesviruses, Picornaviruses, Orthomyxoviruses, Paramyxoviruses, Rhabdoviruses, Hepatitis viruses, AIDS viruses, miscellaneous viruses.
MIC-GE6 (VIROLOGY)
PRACTICALS

Total Lectures : 60
Credits: 2

1. Isolation of bacteriophage from sewage samples.
2. Demonstration of spot assay and turbidity method for detection of lytic bacteriophage.
3. Purification and preparation of high titre of bacteriophage.
4. Enumeration of bacteriophage in a sample by Plaque forming unit method.
6. Demonstration of various tissue culture methods.
7. Demonstration of various egg inoculation techniques.

SUGGESTED READING