SYLLABUS
UNDER NATIONAL EDUCATION POLICY
FOR
FOUR YEARS UNDER-GRADUATE COURSE
IN
MICROBIOLOGY
(w.e.f. *2023-2024*)

BANKURA UNIVERSITY

BANKURA

WESTBENGAL

PIN722155

CONTENTS

1. INTRODUCTION

The National Education Policy (NEP) 2020 highlights that quality higher education must aim to develop good, thoughtful, well-rounded and creative individuals. The NEP recommends that "the undergraduate degree will be of either 3 or 4-year duration, with multiple exit options within this period, with appropriate certifications, e.g., a UG certificate after completing 1 year in a discipline or field including vocational and professional areas, or a UG diploma after 2 years of study, or a Bachelor's degree after a 3-year programme. The 4-year multidisciplinary Bachelor's programme, however, shall be the preferred option since it allows the opportunity to experience the full range of holistic and multidisciplinary education in addition to a focus on the chosen major and minors as per the choices of the student.

In accordance with the NEP 2020, the UGC has formulated a new student-centric "Curriculum and Credit Framework for Undergraduate Programs (CCFUP)" incorporating a flexible choice-based credit system, multidisciplinary approach, and multiple entry and exit options. This will facilitate students to pursue their career path by choosing the subject/field of their interest.

Therefore, the syllabus for Microbiology at undergraduate level framed in such a way that it gives the students a holistic understanding of the subject giving substantial weightage to both the core content and techniques used in Microbiology. The ultimate goal of the syllabus is that the students at the end are able to secure a job. Keeping in mind and in tune with the changing nature of the subject, adequate emphasis has been given on new techniques of mapping and understanding of the subject. The syllabus has also been framed in such a way that the basic skills of subject are taught to the students, and everyone might not need to go for higher studies and the scope of securing a job after graduation will increase.

It is essential that Microbiology students select their minor courses Chemistry as compulsory and any one from the branch of Life Sciences disciplines. While the syllabus is in compliance with UGC model curriculum, it is necessary that Microbiology students should learn "Bioinformatics, Microbes in Sustainable Agriculture and Development & Instrumentation and Biotechniques" as one of the core courses rather than a selective while.

Also, it is been recommended that the Project Work and Industrial Tour/ Institute visit is compulsory for all the students as per their respective semester curriculum.

LEARNING OUTCOME (LO)		
LO	**Summary**	**Description**
LO A:	Sound Domain Knowledge	Acquiring a strong, basic knowledge on origin, evolution and diversification in the applied field of Microbiology.
LO B:	Laboratory Skill	To develop good laboratory skills with latest advanced tools, sophisticated instruments and modern technologies to address emerging problems with scientific viewpoint.
LO C:	Team Work	To develop the spirit of teamwork, learn to harbor collaborative approach to explore new facts and facets of the subject.
LO D:	Academic and Scientific Endeavour	Students will gain cognitive development, innovative approach, technical maneuvering, entrepreneurship and managerial skills to set up a new start-up.
LO E:	Eco-friendly Approach	Futuristic approach to develop eco-friendly management practices to make socio-economic upliftment.
LO F:	Ethical Awareness	To develop ethical awareness among students regarding research & publications.
LO G:	Goal of life	To inculcate visions in students so that they can play a vital role for the advancement of the discipline in the greater benefits of the society.
LEARNING SPECIFIC OUTCOME (LSO)		
LSO	Summary	Description
LSO1:	Rational analysis	Develops fundamental concepts, rational thinking & analytical skill.
LSO2:	Soft Skill Proficiency	Develops communication skill, attitudes, leadership quality, ethical values and social awareness.
LSO3:	Environmental Consciousness	Increases eco-friendly consciousness, waste-management practices.
LSO4:	Hygiene practices	Builds up good habit of hygienic practices.
LSO5:	Scientific attitude	Inculcates research mind & approach to develop eco-friendly bio-products.
LSO6:	Resource management	Develops the knowledge & skill on natural & renewable resource management.
LSO7:	Dry lab practices	Develops ability of sequence analysis & structure prediction.
LSO8:	Awareness against infectious diseases	Develops Awareness against infectious & fatal diseases.
LSO9:	Ecological Awareness	Develops Ecological Awareness among students through Mushroom diversity study in different forest areas of the district.
LSO10:	Skill Development	Students will gain knowledge through different Hands-on-training program on Agro-economic activities.
LSO11:	Social Interaction	Develops Community link up through regular survey on Health & Nutritional parameters of local villagers.
LSO12:	Ethno-medicinal Practices	Develops knowledge on Ethno-medicinal Plants, their commercial usage & worldwide applications.

2. Scheme for NEP Curriculumin Microbiology (Major)

2.1. Credit Distribution across Courses

Course Type		Total Papers	Credits (Theory + Practical)
Major Stream	**Discipline Specific Core (DSC)**	14	14×4= **56**
	Discipline Specific Elective (DSE)	10 (UG Hons.) 7+ 1 Research Project/Dissertation (UG Hons, with Research)	10×4= **40** (UG Hons.) (7×4) + (1×12) = **40** (UG Hons. with Research)
Minor Stream		8	8×4= **32**
Multidisciplinary Courses		3	3×3= **9**
Ability Enhancement Courses (AEC)		4	4×2= **8**
Skill Enhancement Courses (SEC)		3	3×3= **9**
Value Aided Courses (VAC)		2	2×4= **8**
Summer Internship* (Mandatory for Semester-V)		1	1×2= **2**
Totals	**UG Hons.)**	**44 + 1 Summer Internship**	**164**
	UG Hons. with Research	**41+1 Summer Internship+ 1 Research Project/Dissertation**	

*Additional Summer Internship of 4 credit is mandatory for certificate and diploma courses.

2.2. Scheme for NEP based Curriculum in Microbiology (Major)

SEMESTER –I

Course Code	Course Title	Credit	Marks		
			I.A.	ESE	Total
S/MCB/101 /MJC-1	Introduction to Microbiology and Microbial Diversity	4 (T +P)	10	40 (T 25+P 15)	50
S/MCB/102 /MN-1	Introduction to Microbiology and Microbial Diversity (For students of other discipline)	4 (T +P)	10	40 (T 25+P 15)	50
S/MCB/ 103 MD-1	Microbial Diagnosis in Health Clinics (For students of other discipline)	3 (T)	10	40 (T 40)	50
S/MCB/104 /SEC-1	Microbial Diagnosis in Health Clinics	3 (P)	10	40 (P 40)	50
ACS/105/ AEC-1	Compulsory English: Literature and Communication	2	10	40	50
ACS/106/ VAC 1	ENVS	4	10	40	50
Total		20	60	240	300

SEMESTER –II

Course Code	Course Title	Credit	Marks		
			I.A.	ESE	Total
S/MCB/201/ MJC-2	Bacteriology	4 (T +P)	10	40 (T 25+P 15)	50
S/MCB/202/ MN-2	Bacteriology (For students of other discipline)	4 (T +P)	10	40 (T 25+P 15)	50
S/MCB/ 203 MD-2	Microbiological Analysis of Air and Water (For students of other discipline)	3 (T)	10	40 (T 40)	50
S/MCB/204/ SEC-2	Microbiological Analysis of Air and Water	3 (P)	10	40 (P 40)	50
ACS/205/ AEC-2	MIL-1 (Santali/Bengali/Sanskrit)	2	10	40	50
ACS/206/ VAC 2	Health and wellness/Understanding India: Indian Philosophical Traditions and Value Systems /Basics of Indian Constitution/ /Arts and Crafts of Bengal/Historical Tourism in WB/Basics of Indian Constitution	4	10	40	50
	Total	20	60	240	300

Question Pattern

MJC, MJE and MN papers (Theory F.M: 25 & Practical F.M: 15)

Theory	**F.M: 25**	**Practical**	**F.M: 15**
UNIT-I		1.Work out/Demonstration/Experiment:	10/9
1. Any five out of eight	5×1=5		
UNIT-II		2.Laboratory Record/ Field Report:	2/3
2. Any two out of four	2×5=10	3.Viva Voce:	3
UNIT-III			
3. Any one out of two	1×10=10		

SEC Papers (Practical F.M: 40)

Practical	**F.M: 40**
1.Work out (Major):	15
2. Work out (Minor)/ Demonstration:	10
3. Laboratory Record/ Field Report:	5
4.Viva Voce:	10

Multidisciplinary Papers: (Theory F.M: 40)

Theory	**F.M: 40**
UNIT-I	
Any five out of eight	5×2=10
UNIT-II	
Any four out of six	4×5=20
UNIT-III	
Any one out of two	1×10=10

3. Major Stream:
Discipline Specific Core (DSC) Courses

Semester – I

MJC-1: Introduction to Microbiology and Microbial Diversity

Course Code: S/MCB/101/MJC-1 **Credit: 4**

(Theory: Lectures 40 /Marks 25)

Learning Outcome

- The students will gain a holistic concept on history, development, scope and aspects of Microbiology. They will also learn about the contributions of Microbiologists.
- Students learn about the diversity of microbial world, kingdom and domain concept; features of dark field-, phase contrast- & electron microscopes.
- Students will achieve knowledge on habitat, distribution, nutritional requirements, ultra-structure, thallus organization and aggregation of algae and fungi.
- Students will gain knowledge on General characteristics & Economic importance of Protozoa.
- Students will be made aware of biosafety protocols and laboratory management.

Unit 1 History and Development of Microbiology	**lectures 8**
History, Development and Scope of microbiology Theory of Spontaneous generation, Germ theory of disease. Contributions of Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner, Paul Ehrlich, Martinus W. Beijerinck, and Sergei N. Winogradsky in the field of Microbiology.	
Unit 2 Diversity of Microbial World	**Lectures 4**
Systems of classification: Basic idea about Hackel and Whittaker's kingdom concept and domain concept of Carl Woese. Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain.Generalcharacteristicsandrepresentativemembersofdifferentgroups: Cellular microorganisms (Archaea, Bacteria, Algae, Fungi and Protozoa). Acellular microorganisms (Viruses, Viroids, Prions).	
Unit3 Basic Microscopy	**Lectures 4**
Principle of Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope.	
Unit4 Phycology	**Lectures 10**
General characteristics of algae: occurrence, thallus organization, cell ultrastructure, pigments, flagella, eye spot, food reserves and vegetative, asexual and sexual reproduction. Economic importance of algae.	
Unit 5 Mycology	**Lectures 10**
General characteristics of fungi: habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallus organization and aggregation. Economic importance of fungi.	

Unit 6 Protozoa	**Lectures 4**
General characteristics of protozoa: Occurrence, cell ultra-structure, organs and appendages, nutrition, locomotion and economic importance.	

ReferenceBooks

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition.
2. Madigan M T, Martinko J M, Dunlap P V and Clark D P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Cappuccino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley J M, Sherwood L M and Woolverton C J. (2013) Prescott's Microbiology.9th Edition. McGraw-Hill International.
5. Atlas R M. (1997). Principles of Microbiology.2nd edition. W.M.T. Brown Publishers.
6. Pelczar M J,Chan ECS and Krieg NR.(1993). Microbiology. 5th edition. McGraw Hill Book Company.

PRACTICAL

Lectures: 30 **Marks: 15**

List of Practical

1. Microbiology Laboratory Management and Biosafety
2. To study the principle and applications of important instruments(autoclave, incubator, hot air oven, centrifuge, light microscope, pH meter) used in the microbiology laboratory
3. Preparation of culture media(Nutrient Broth and Nutrient Agar)for bacterial cultivation
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven
6. Sterilization of heat sensitive material by filtration.
7. Motility test by hanging drop method.
8. Study of *Penicillium* using permanent mounts.
9. Study of *Chlamydomonas* using permanent Mounts.
10. Study of *Paramecium* using permanent mounts.

Semester - II

MJC 2: BACTERIOLOGY

Course Code: S/MCB/201/MJC-2 **Credit:4**

(Theory: Lectures 40 /Marks 25)

Learning Outcome

- Students get a prominent knowledge on detailed cell organization, arrangement and other characteristic features of a bacterial cell.
- Students learn about various physical & chemical methods of microbial control.
- Students will learn about bacterial growth, nutrition, motility and reproduction processes.
- Students perform pure cultures techniques to isolate, study, identify and preserve bacterial strains.

Unit 1 Cell organization	**Lectures: 10**
Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Differences between Eubacteria and archaebacteria. Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasmic inclusions. Endospore: Structure, formation, stages of sporulation.	
Unit 2 Bacteriological techniques	**Lectures: 6**
Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and Preservation / stocking of pure cultures; cultivation of an aerobic bacteria, and accessing non-culturable bacteria.	
Unit 3 Growth and nutrition	**Lectures: 6**
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 media and enrichment technique.	
Unit 4 Reproduction in Bacteria	**Lectures: 6**
Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.	
Unit 5 Important archaeal and eubacterial groups	**Lectures:8**
Archaebacteria: General characteristics, suitable example and economic importance. **Eubacteria:** General characteristics with suitable example. Non proteo-bacteria, Proteo-bacteria; Low G+C (Firmicutes), High G+C (Actinobacteria).	

***Cyanobacteria*:** Introduction & economic importance.

Unit6 Culture preservation techniques **Lectures: 4**

Short-term preservation methods: slant, stab, mineral oil

Long-term preservation methods: lyophilization, cryopreservation

Reference Books

1. Atlas RM. (1997). Principles of Microbiology.2nd edition M. T. Brown Publishers.
2. BlackJG.(2008).Microbiology:PrinciplesandExplorations.7thedition.PrenticeHall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS, and Krieg NR. (2004). Microbiology. 5th edition Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005).General Microbiology.5th edition McMillan.
7. Tortora GJ, Funke BR,and Case CL.(2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. Cappucino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

PRACTICAL

Lectures: 30 **Marks: 15**

List of Practical

1. Preparation of broth and agar media.
2. Simple staining
3. Gram's staining
4. Acid fast staining.
5. Endospore staining.
6. Isolation of pure cultures of bacteria from soil by spread plate method.
7. Isolation of pure cultures of bacteria from water by pour plate and streak plate method.
8. Preservation of bacterial cultures (slant and stab).
9. Isolation and enumeration of bacteria from air.
10. Report a visit to any Institute/Industry.

4. Major Stream:
Discipline Specific Elective (DSE) Courses

5. Minor Stream

Semester - I

MN-1: Introduction to Microbiology and Microbial Diversity

Couse Code: S/MCB/102/MN-1 **Credit: 4**

(Theory: Lectures 40 /Marks 25)

Learning Outcome

- The students will gain a holistic concept on history, development, scope and aspects of Microbiology. They will also learn about the contributions of Microbiologists.
- Students learn about the diversity of microbial world, kingdom and domain concept; features of dark field-, phase contrast- & electron microscopes.
- Students will achieve knowledge on habitat, distribution, nutritional requirements, ultra-structure, thallus organization and aggregation of algae and fungi.
- Students will gain knowledge on General characteristics & Economic importance of Protozoa.
- Students will be made aware of biosafety protocols and laboratory management.

Unit 1 History and Development of Microbiology	**Lectures 8**
History, Development and Scope of microbiology Theory of Spontaneous generation, Germ theory of disease. Contributions of Antonie van Leeuwenhoek, Louis Pasteur, Robert Koch, Joseph Lister, Alexander Fleming, Edward Jenner, Paul Ehrlich, Martinus W. Beijerinck, and Sergei N. Winogradsky in the field of Microbiology.	
Unit 2 Diversity of Microbial World	**Lectures 4**
Systems of classification: Basic idea about Hackel and Whittaker's kingdom concept and domain concept of Carl Woese. Aim and principles of classification, systematics and taxonomy, concept of species, taxa, strain.Generalcharacteristicsandrepresentativemembersofdifferentgroups: Cellular microorganisms (Archaea, Bacteria, Algae, Fungi and Protozoa). Acellular microorganisms (Viruses, Viroids, Prions).	
Unit 3 Basic Microscopy	**Lectures 4**
Principle of Bright Field Microscope, Dark Field Microscope, Phase Contrast Microscope.	
Unit 4 Phycology	**Lectures 10**
General characteristics of algae: occurrence, thallus organization, cell ultrastructure, pigments, flagella, eye spot, food reserves and vegetative, asexual and sexual reproduction. Economic importance of algae.	
Unit 5 Mycology	**Lectures 10**
General characteristics of fungi: habitat, distribution, nutritional requirements, fungal cell ultra-structure, thallus organization and aggregation. Economic importance of fungi.	

Unit 6 Protozoa	**Lectures 4**
General characteristics of protozoa: Occurrence, cell ultra-structure, organs and appendages, nutrition, locomotion and economic importance.	

Reference Books

1. Tortora GJ, Funke BR and Case CL. (2008). Microbiology: An Introduction. 9th edition.
2. Madigan M T, Martinko J M, Dunlap P V and Clark D P. (2014). Brock Biology of Microorganisms. 14th edition. Pearson International Edition.
3. Cappuccino J and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited
4. Wiley J M, Sherwood L M and Woolverton C J. (2013) Prescott's Microbiology.9th Edition. McGraw-Hill International.
5. Atlas R M. (1997). Principles of Microbiology.2nd edition. W.M.T. Brown Publishers.
6. Pelczar M J,Chan ECS and Krieg NR.(1993). Microbiology. 5th edition. McGraw Hill Book Company.

PRACTICAL

Lectures: 30 **Marks: 15**

List of Practical

1. Microbiology Laboratory Management and Biosafety
2. To study the principle and applications of important instruments(autoclave, incubator, hot air oven, centrifuge, light microscope, pH meter) used in the microbiology laboratory
3. Preparation of culture media(Nutrient Broth and Nutrient Agar)for bacterial cultivation
4. Sterilization of medium using Autoclave and assessment for sterility
5. Sterilization of glassware using Hot Air Oven
6. Sterilization of heat sensitive material by filtration.
7. Motility test by hanging drop method.
8. Study of *Penicillium* using permanent mounts.
9. Study of *Chlamydomonas* using permanent Mounts.
10. Study of *Paramecium* using permanent mounts.

Semester - II

MN-2: BACTERIOLOGY

Course Code: S/MCB/202/MN-2 **Credit: 4**

(Theory: Lectures 40 /Marks 25)

Learning Outcome

- Students get a prominent knowledge on detailed cell organization, arrangement and other characteristic features of a bacterial cell.
- Students learn about various physical & chemical methods of microbial control.
- Students will learn about bacterial growth, nutrition, motility and reproduction processes.
- Students perform pure cultures techniques to isolate, study, identify and preserve bacterial strains.

Unit 1 Cell organization	**Lectures: 10**
Cell size, shape and arrangement, glycocalyx, capsule, flagella, endoflagella, fimbriae and pili. Cell-wall: Composition and detailed structure of Gram-positive and Gram-negative cell walls, Archaebacterial cell wall, Differences between Eubacteria and archaebacteria. Gram and acid-fast staining mechanisms, lipopolysaccharide (LPS), sphaeroplasts, protoplasts, and L-forms. Cell Membrane: Structure, function and chemical composition of bacterial and archaeal cell membranes. Cytoplasmic inclusions. Endospore: Structure, formation, stages of sporulation.	
Unit 2 Bacteriological techniques	**Lectures: 06**
Pure culture isolation: Streaking, serial dilution and plating methods; cultivation, maintenance and Preservation / stocking of pure cultures; cultivation of an aerobic bacteria, and accessing non-culturable bacteria.	
Unit 3 Growth and nutrition	**Lectures: 06**
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 media and enrichment technique.	
Unit 4 Reproduction in Bacteria	**Lectures: 06**
Definitions of growth, measurement of microbial growth, Batch culture, Continuous culture. Asexual methods of reproduction, logarithmic representation of bacterial populations, phases of growth, calculation of generation time and specific growth rate.	
Unit 5 Important archaeal and eubacterial groups	**Lectures: 08**
Archaebacteria: General characteristics, suitable example and economic importance.	

Eubacteria: General characteristics with suitable example.

Non proteo-bacteria, Proteo-bacteria; Low G+C (Firmicutes), High G+C (Actinobacteria).

***Cyanobacteria*:** Introduction & economic importance.

Unit6 Culture preservation techniques **Lectures: 04**

Short-term preservation methods: slant, stab, mineral oil

Long-term preservation methods: lyophilization, cryopreservation

Reference Books

1. Atlas RM. (1997). Principles of Microbiology.2nd edition. W. M. T. Brown Publishers.
2. BlackJG.(2008).Microbiology:PrinciplesandExplorations.7thedition.PrenticeHall
3. Madigan MT, and Martinko JM. (2014). Brock Biology of Micro-organisms. 14th edition. Parker J. Prentice Hall International, Inc.
4. Pelczar Jr MJ, Chan ECS,and Krieg NR. (2004). Microbiology. 5th edition, Tata McGraw Hill.
5. Srivastava S and Srivastava PS. (2003). Understanding Bacteria. Kluwer Academic Publishers, Dordrecht
6. Stanier RY, Ingraham JL, Wheelis ML and Painter PR. (2005).General Microbiology.5th edition McMillan.
7. Tortora GJ, Funke BR,and Case CL.(2008). Microbiology: An Introduction. 9th edition Pearson Education.
8. Willey JM, Sherwood LM, and Woolverton CJ. (2013). Prescott's Microbiology. 9th edition. McGraw Hill Higher Education.
9. CappucinoJ and Sherman N. (2010). Microbiology: A Laboratory Manual. 9th edition. Pearson Education Limited

PRACTICAL

Lectures: 30 **Marks: 15**

List of Practical

1. Preparation of broth and agar media.
2. Simple staining
3. Gram's staining
4. Acid fast staining.
5. Endospore staining.
6. Isolation of pure cultures of bacteria from soil by spread plate method.
7. Isolation of pure cultures of bacteria from water by pour plate and streak plate method.
8. Preservation of bacterial cultures (slant and stab).
9. Isolation and enumeration of bacteria from air.
10. Report a visit to any Institute/Industry.

6. Multidisciplinary Courses

Semester - I

MD-1:MICROBIAL DIAGNOSIS IN HEALTH CLINICS

Course Code: S/MCB/ 103/MD-1 **Credit: 3**

(Theory: Lectures 30 /Marks 40)

Unit 1: Importance of Diagnosis of Diseases	**Lectures: 02**
Bacterial, Viral, Fungal and Protozoan Diseases of various human body systems, Disease associated clinical samples for diagnosis	
Unit 2: Collection of Clinical Samples	**Lectures: 04**
Collection of clinical samples(Sputum, Skin, Blood, Urine and Stool)with proper precautions Method of transport of clinical samples to the laboratory and storage	
Unit 3: Direct Microscopic Examination and Culture	**Lectures: 04**
Examination of sample by staining - Gram staining, Ziehl-Neelson staining, Giem sustaining Preparation and use of culture media-Blood agar, Chocolate agar, Lowenstein-Jensen medium, MacConkey agar.	
Unit 4:Serological and Molecular Methods	**Lectures: 06**
Serological Methods -Agglutination, ELISA, Immunofluorescence, Nucleic acid based methods -PCR, Nucleic acid probes	
Unit 5: Kits for Rapid Detection of Pathogens	**Lectures: 04**
Typhoid, Dengue and HIV	
Unit 6:Testing for Antibiotic Sensitivity in Bacteria	**Lectures: 10**
Determination of resistance/sensitivity of bacteria against antibiotic (Penicillin/Streptomycin) using disc diffusion method. Determination of minimal inhibitory concentration (MIC) of an antibiotic (Penicillin/Streptomycin).	
Reference Books	

1. Ananthanarayan R and Paniker C K J (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. BrooksG.F.,CarrollK.C.,ButelJ.S.,MorseS.A.andMietzner,T.A.(2013)Jawetz,MelnickandAdelberg'sMedicalMicrobiology.26th edition. McGraw Hill Publication
3. Collee JG, Duguid JP, Fraser AG, Marmion BP(1989) Practical Medical Microbiology, 13th edition, Churchill Livingstone
4. Randhawa,VS,MehtaGandSharmaKB(2009)PracticalsandVivainMedicalMicrobiology 2nd edition, Elsevier India Pvt Ltd

Semester - II

MD-2: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER (T)

Course Code: S/MCB/ 203/ MD-2 **Credit: 3**

(Theory: Lectures 30 /Marks 40)

Unit 1 Aeromicrobiology	**Lectures: 06**
Bioaerosols, Airborne microorganisms(bacteria, Viruses, fungi, each from every category)and their Impact on human health, and environment, significance in food and pharma industries and operation theatres, allergens.	
Unit 2 Air Sample Collection and Analysis	**Lectures: 06**
Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics	
Unit 3 Control Measures	**Lectures: 04**
Fate of Bioaerosols, inactivation mechanisms –UV light, HEPA filters, desiccation, Incineration	
Unit 4 Water Microbiology	**Lectures: 04**
Water borne pathogens, water borne diseases	
Unit 5 Microbiological Analysis of Water	**Lectures: 06**
Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a)standard qualitative procedure: presumptive/MPN tests, confirmed and completed Tests for faecal coliforms (b)Membrane filter technique and (c) Presence/absence tests	
Unit 6 Control Measures	**Lectures: 04**
Precipitation, chemical disinfection, filtration, high temperature, UV light	

Reference Books

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water. A Laboratory Manual, CRC Press

2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA

3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press

4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press

7. Skill Enhancement Courses

Semester - I

SEC-1: MICROBIAL DIAGNOSIS IN HEALTH CLINICS (P)

Course Code: S/MCB/104/SEC-1 **Credits: 3**

(Practical: Lectures 30 /Marks 40)

Learning Outcome

- Students will gain knowledge and hands-on-training regarding diagnostic procedures in health clinics.

PRACTICAL	
Unit 1:	**Lectures: 06**
Collection of clinical samples(Sputum, Skin, Blood, Urine and Stool) with proper precautions	
Unit 2:	**Lectures: 04**
Method of transport and storage of clinical samples	
Unit 3:	**Lectures: 04**
Examination of sample by staining - Gram staining, Ziehl-Neelson staining	
Unit 4:	**Lectures: 06**
Preparation and use of culture media-Blood agar, Chocolate agar, TCBS Agar, MacConkey agar	
Unit 5:	**Lectures: 02**
Rapid Detection of Typhoid	
Unit 6:	**Lectures: 04**
Determination of resistance/sensitivity of bacteria against antibiotic (Penicillin/Streptomycin) using disc diffusion method	
Unit 7:	**Lectures: 04**
Determination of minimal inhibitory concentration (MIC) of an antibiotic (Penicillin/ Streptomycin)	

Reference Books

1. Ananthanarayan R and Paniker CKJ (2009) Textbook of Microbiology, 8th edition, Universities Press Private Ltd.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013) Jawetz, Melnick and Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
3. Collee JG, Duguid JP, Fraser AG, Marmion BP(1989) Practical Medical Microbiology, 13th edition, Churchill Livingstone
4. Randhawa, VS, Mehta G and Sharma KB (2009) Practicals and Viva in Medical Microbiology

Semester - II

SEC-2: MICROBIOLOGICAL ANALYSIS OF AIR AND WATER (P)

Course Code: S/MCB/204/SEC-2 **Credits: 3**

(Practical: Lectures 30 /Marks 40)

Learning Outcome

- Students will gain knowledge about microbiological analysis of air and water.

PRACTICAL	
Unit 1 Aeromicrobiology	**Lectures: 06**
Bioaerosols, Airborne microorganisms(bacteria, Viruses, fungi, each from every category)and their Impact on human health, and environment, significance in food and pharma industries and operation theatres, allergens.	
Unit 2 Air Sample Collection and Analysis	**Lectures: 04**
Bioaerosol sampling, air samplers, methods of analysis, CFU, culture media for bacteria and fungi, Identification characteristics	
Unit 3 Control Measures	**Lectures: 04**
Fate of bioaerosols, inactivation mechanisms –UV light, HEPA filters, desiccation, Incineration	
Unit 4 Water Microbiology	**Lectures: 04**
Water borne pathogens, water borne diseases	
Unit 5 Microbiological Analysis of Water	**Lectures: 06**
Sample Collection, Treatment and safety of drinking (potable) water, methods to detect potability of water samples: (a)standard qualitative procedure: presumptive/MPN tests, confirmed and completed Tests for faecal coliforms (b)Membrane filter technique and (c) Presence/absence tests	
Unit 6 Control Measures	**Lectures: 06**
Precipitation, chemical disinfection, filtration, high temperature, UV light	

Reference Books

1. da Silva N, Taniwaki MH, Junqueira VC, Silveira N, Nascimento MS, Gomes RAR (2012) Microbiological Examination Methods of Food and Water, A Laboratory Manual, CRC Press
2. Atlas RM and Bartha R. (2000). Microbial Ecology: Fundamentals & Applications. 4th edition. Benjamin/Cummings Science Publishing, USA
3. Maier RM, Pepper IL and Gerba CP. (2009). Environmental Microbiology. 2nd edition, Academic Press
4. Hurst CJ, Crawford RL, Garland JL, Lipson DA (2007) Manual of Environmental Microbiology, 3rd edition, ASM press